CALIFORNIA SEWAGE WORKS JOURNAL

Official Publication of the California Sewage Works Association

Vol. XII :: 1940 :: No. 1

Minutes of the Twelfth Annual Fall Convention at Oakland, California, September 18-19, 1939

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Richmond-Sunset Sewage Treatment Plant

★

Sewage Pumping and Disposal at Treasure Island

★

Water Pollution

★

Navigable Waters — Interstate Streams

★

San Francisco Bay and Ocean Shore

★

Sportsman's Viewpoint

BEAR BRAND

GREAT WESTERN DIVISION
BEAR BRAND PRODUCTS
THE DOW CHEMICAL COMPANY

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Affiliated with the National Federation of Sewage Works Associations

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California Sewage Works Journal

Published by CALIFORNIA SEWAGE WORKS ASSOCIATION

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TWELFTH ANNUAL FALL CONVENTION

OAKLAND, CALIFORNIA

SEPTEMBER 18-19, 1939

PROGRAM

Registration:

6:00-8:00 P. M.—Sunday, September 17
7:30-9:30 A. M.—Monday, September 18

Monday Morning, September 18, 1939

7:30 A. M.—Operators' Breakfast—French Room
7:30 A. M.—Directors' Breakfast—Room 202
9:00 A. M.—Business Meeting—Parlor A
10:00 A. M.—"Problems in the Operation of the Richmond-Sunset Sewage Treatment Plant" by Ben Benas, Superintendent Richmond-Sunset Disposal Plant
Discussion led by:
Chas. Gilman Hyde, Professor Sanitary Engineering, University of California
11:15 A. M.—"Sewage Pumping and Disposal at Treasure Island" by Charles H. Lee, Chief Division Water Supply and Sanitation, G. G. I. E.
12:00 Noon—Luncheon, Hotel Leamington Bowl
Address of Welcome: Dr. William J. McCracken, Mayor, City of Oakland
Reply: Alexander Bell

Monday Afternoon, September 18, 1939

2:00 P. M.—Assemble for Caravan on Webster, north of 19th Street
2:40 P. M.—Visit Marina Pumping Plant, San Francisco.
3:30 P. M.—Visit Activated Sludge Plant, Golden Gate Park
4:00 P. M.—Visit Richmond-Sunset Plant
5:30 P. M.—Disband for Hotels or Exposition

Tuesday Morning, September 19, 1939

Joint Session with Engineers' Section of the League of California Municipalities, Hotel Leamington
7:45 A. M.—Breakfast with Engineers' Section of the League — Hotel Leamington, Castilian Room
9:00 A. M.—Technical Meeting, Leamington Bowl

9:15 A. M.—"Pollution of Navigable Waters or Interstate Streams from the Standpoint of Federal Government or Army Engineers" by Edwin C. Kelton, Lt. Col., Corps of Engineers, U. S. Army

9:45 A. M.—Discussion led by:
A. M. Rawn, Assistant Chief Engineer Los Angeles County Sanitation Districts

10:00 A. M.—"Pollution of San Francisco Bay, the Ocean Shore and the Effect of Sewage Treatment" by A. B. Crowley, Chief Inspector, Division of Industrial Hygiene, City of San Francisco

10:45 A. M.—Discussion led by:
J. F. Byxbee, City Engineer, Palo Alto.

11:15 A. M.—"Pollution of Harbors and Streams from the Viewpoint of the Sportsman" by Howard Vernon, Author Striped Bass Bill and other legislation

12:00 Noon—Adjournment

Tuesday Afternoon, September 19, 1939

C. S. W. A. Day at the Exposition

COMMITTEE ON LOCAL ARRANGEMENTS

Victor W. Sauer, *Chairman*
Blair Burnson
Joseph Corrao
Herbert B. Foster
Louis P. H. Meyer
Sam Weed

LADIES' PROGRAM

Ladies are expressly invited to take part in all the Ladies' events planned by the League of California Municipalities. For the program see the Western City Magazine.

TWELFTH ANNUAL SPRING MEETING AT CATALINA ISLAND, MAY 19-20-21, 1940

TENTATIVE AND CONDENSED PROGRAM

SUNDAY, MAY 19

Leave Catalina Docks, Wilmington, 10:00 a.m., arriving at the Island at noon. Headquarters—Saint Catherine Hotel.

Lunch and dinner, as individual may elect.

2:00 p.m.—Registration—committee meeting—golf tournament—sightseeing.

7:00 to 8:00 p.m.—Movies, "A trip through a Modern Electric Manufacturing Plant"; "The Columbus Sewage Treatment Plant," Courtesy General Electric Co.

MONDAY, MAY 20

7:30 a.m.—Directors' breakfast and operators' breakfast.

9:00 to 9:30 a.m.—Business meeting—committee reports.

9:30 a.m. to noon—Technical papers, by Harold F. Gray, Reuben F. Brown; (Fred D. Bowlus, discussion); Richard Pomeroy.

1:45 to 5:00 p.m.—Technical papers, by Franklin Thomas (discussion by Chas. Gilman Hyde); A. H. Koebig (discussion by R. F. Goudey); Paul R. Shaw; Frank A. Short.

Discussion re: plant award and plaque, by Alexander Bell.

7:30 p.m.—Banquet, St. Catherine Hotel. Speaker, Dean W. Ballentine Henley, University of Southern California.

TUESDAY, MAY 21

9:00 a.m. to noon—Technical papers by B. D. Phelps; H. G. Smith; and E. G. Studley (discussion by E. M. Kelley); George Best.

Brief discussion on interesting plant problems, features or gadgets, by J. C. Clark; J. H. Harrington; C. F. Tennant; A. E. Fiscus; H. L. May; R. D. Woodward (discussion by G. A. Parkes).

Noon to 3:30 p.m. — Luncheon and sightseeing. Steamer leaves Catalina Island at 4:00 p.m. for Wilmington.

Luncheon and special entertainment for the ladies May 20

Special convention rates being arranged.

Parking and storage for automobiles available at Catalina Docks, Wilmington.

TWELFTH ANNUAL FALL CONVENTION
CALIFORNIA SEWAGE WORKS ASSOCIATION
Oakland, California, Sept. 18-19, 1939

MINUTES OF THE MEETING

Monday, September 18, 1939

The Twelfth Annual Fall Convention of the California Sewage Works Association was called to order by President Alexander Bell at the hour of 9:00 A. M., Monday, September 18, 1939, in the Mezzanine Parlor of the Hotel Leamington, with 80 members and guests in attendance.

In opening the meeting, President Bell said there was a very full program ahead, but that the meetings would be kept on time so that members of the Association and their guests might keep appointments to visit the Golden Gate International Exposition on Treasure Island.

A brief résumé of the Directors' meeting was given by President Bell, who then called upon William A. Allen, Chairman of the Operators' Breakfast, for a report. Mr. Allen reported that the Operators' Breakfast, an innovation, was a huge success, and that the 26 operators present unanimously voted to hold such a breakfast for the discussion of operators' problems at each future convention and conference. The principal items of discussion were plant records and mechanical equipment; the conclusions being that good records should reflect the behavior of the plant and its operators, thereby giving much assistance in case of law suits; and that ball valve sludge pumps foul easily and are most difficult to maintain.

Committee reports were called for and Fred Bowlus, Chairman of the Membership Committee, responded first, saying that while the goal of 300 members by the Fall Convention was not attained, the Association had a healthy growth, particularly of new sewage treatment plant operators, the paid up memberships as of date being 263. It was further reported that but 26 members were in arrears in dues.

Mr. John A. Clark, Chairman Publicity Committee, stated that at the time of his reporting over 200 column inches of publicity had been given to the Fall Convention by the Metropolitan Dailies. He exhibited an excellent scrap book containing publicity clippings appertaining to the Visalia Spring Conference and Oakland Convention to be passed on to the new Chairman of this Committee. In closing, Mr. Clark acknowledged the assistance given him by Mr. Bob Van Etten, Educational Assistant of the Alameda County Mosquito Abatement District.

Chairman J. F. Smith of the Finance Committee reported that while there was a small deficiency in the financing of Vol. XI, No. 1, of the Journal that additional advertising had been obtained for Vol. XI, No. 2, restoring the publishing of the Journal to a sound financial basis.

Mr. A. M. Rawn, Chairman Legislative Committee, reported the committee had taken no action since the Spring Conference.

President Alexander Bell said the report of the Award Committee would be made at the Joint Breakfast meeting with the Engineers' Section of the League of California Municipalities. Mr. May's written report as Chairman of the Award Committee is published elsewhere in the Journal.

Mr. A. Perry Banta, Chairman of the Certification and Schools Committee, submitted a written report, which is printed elsewhere in this Journal.

The standing committees having reported, a call for reports from special committees was made.

R. Pomeroy, Chairman of the Fact Finding Committee, stated that his committee had assembled much information upon primary clarifiers and that a report of findings upon this unit of the sewage treatment works might be presented at the Spring Conference in 1940. A program is laid out for the committee to study in a predetermined order the several components of sewage treatment plants.

Mr. William T. Ingram, Secretary-Treasurer San Joaquin Section, submitted a report of the Section which is printed in the Journal.

The report of the Nominating Committee, consisting of William A. Allen, Ben Benas and A. Perry Banta, was made by Chairman Allen. The following members were placed in nomination:

For President, H. G. Smith; First Vice-President, Harold F. Gray; Second Vice-President, Fred Bowlus; Director 1944, Alexander Bell; Director 1941, to fill the unexpired term of A. M. Rawn who presented his resignation due to pressure of other business, Howard Jewell; Secretary-Treasurer, William T. Ingram.

There being no other nominations from the floor, it was moved, seconded and carried that the Secretary cast a unanimous ballot for the candidates as nominated by the Nominating Committee.

The Secretary explained the proposed Constitutional Amendments, saying that they were approved by the Directors as printed and distributed to the members as an enclosure with the program for the Convention. It was asked if anyone desired to discuss or question any of the amendments. There being no discussion, it was moved, seconded and carried that the amendments be approved as printed.

Under new business it was moved by R. Pomeroy and seconded by A. Koebig that a short school for operators be held every year at the University of Southern California.

In discussion of the motion, Mr. Banta said that the few members who have put on the previous schools at Los Angeles would not welcome the work entailed in a course every year and that such a program would bring an early climax to the schools.

Mr. William A. Allen moved that Mr. Pomeroy's motion be tabled. This motion was seconded and carried.

The Business Meeting was closed promptly at 10:00 A. M. and the Technical Session opened.

The first paper, "Problems in the Operation of the City of San Francisco Richmond-Sunset Sewage Treatment Plant," was presented by Mr. Ben Benas, Superintendent of the Plant. Mr. Benas' paper was followed by brief written discussions by Keeno Fraschina and R. R. Sotter, Assistant Superintendent and Chief Operating Engineer, respectively, of the Richmond-Sunset

Plant. Professor Charles Gilman Hyde gave a most interesting extemporaneous discussion of Mr. Benas' paper which brought out many items as food for thought.

The second paper, "Sewage Pumping and Disposal at Treasure Island," was presented by Charles H. Lee, Chief Division of Water Supply and Sanitation, G. G. I. E.

Mr. Morris Cohn, Editor of Municipal Sanitation, was introduced and extended the greetings from the East to the West.

Announcement was made of the caravan for the afternoon and the meeting adjourned for luncheon.

At the noon luncheon Walter N. Frickstad, City Engineer of Oakland, extended a word of welcome on behalf of Mayor McCracken of our host City. Mr. Frickstad told of the sewage disposal problem of the City of Oakland and its neighbors and said that the warm Indian summer weather, a low tide and gentle westerly breezes would fully acquaint those attending the caravan in the afternoon with the seriousness of the situation existing along the Bay shore.

President Bell in reply remarked "that it is gratifying to find that the East Bay Cities are attacking a difficult problem in a serious manner" and offered the services of the C. S. W. A. should they be of any assistance.

The afternoon was occupied by a caravan to visit the City of San Francisco sewage disposal facilities consisting of the New Marina Sewage Pumping Plant which is completely underground, the only evidence of its presence above ground being a flag pole vent; the Golden Gate Park Activated Sludge Plant treating about a million gallons of sewage per day, the effluent from which is used for irrigation and to create park lakes; and the new Richmond-Sunset Sewage Treatment Plant located in the most westerly end of Golden Gate Park, placed in operation in April, 1939, and treating the sewage of a residential area with a present population of 150,000 and an estimatd future population of 300,000.

Tuesday, September 19, 1939

The Tuesday program opened with a joint breakfast of the Association and the Engineers' Section of the League of Municipalities in the Castilian Room of the Hotel Leamington, with President Harry Goodridge of the Engineers' Section of the League presiding. A humorous talk on Astronomy by Max Horwinski started the morning with a good laugh.

The gavel was given to President Bell for the purpose of presenting the Award of Merit. Chairman May gave a brief report of the Award Committee and President Bell presented the first award, a metal plaque and a check for $25.00, to Mr. A. J. Castro, operator of the Santa Clara Sewage Treatment Plant. The second award was won by the City of Lodi. The third award was not made.

The Technical Session was called promptly at 9:00 A. M. by President Alexander Bell in the Leamington Bowl. There were 120 members and guests in attendance.

Three papers were presented. Col. Edwin C. Kelton's paper, "Pollution of Navigable Waters or Interstate Streams from the Standpoint of the Federal Government," was read by Captain N. A. Mathais and was discussed by A. M. Rawn.

Howard Vernon, for many years the champion of the sportsmen's case for the curtailment of pollution, read his paper, "Pollution of Harbors and Streams from the Viewpoint of the Sportsman."

The third paper, "Pollution of San Francisco Bay and the Effect of Sewage Treatment," was presented by the author, A. B. Crowley, and was discussed by J. F. Byxbee.

After the introduction of guests and a short address by Morris Cohn, the meeting adjourned.

Respectfully submitted,

R. R. Ribal,

Secretary-Treasurer.

REPORT OF THE SECRETARY-TREASURER
CALIFORNIA SEWAGE WORKS ASSOCIATION
September 18, 1939

BALANCE AS OF SEPTEMBER 6, 1938		$ 627.32
CASH RECEIPTS:		
Membership Dues, 1938	$ 40.00	
" " 1939	520.50	
" " 1940	2.00	
Journal Sales	3.00	
Fees, Applicants of Certification	8.00	
Journal Advertising	605.00	
Refunds and Miscellaneous	15.95	
		1,194.45
TOTAL RECEIPTS		$1,821.77
CASH DISBURSEMENTS:		
Printing, Mailing Journal, Vol. 10, No. 2	$279.80	
" " " Vol. 11, No. 1	324.28	
Federation Dues, 1938	34.50	
" " 1939	395.50	
Stenographic Service, Misc.	41.79	
Stationery, Printing, Stamps	122.35	
Award of Merit	25.00	
Convention Expense	53.69	
Schools	25.00	$1,301.91
CASH ON HAND		$ 519.86
TOTAL DISBURSEMENTS		$1,821.77

OUTSTANDING BILLS

Printing Jl.—Vol. 11, No. 2	$265.66	
Printing Programs	14.94	
Miscellaneous Expense of the Secretary	3.56	$ 284.16

ACCOUNTS RECEIVABLE

Advertising	$ 107.50

DEBIT OUTSTANDING AS OF SEPTEMBER 18, 1939 $ 176.66

REPORT ON CERTIFICATION OF OPERATOR'S ACCOUNT

(A total of 113 operators have been certified; one application is pending.)

Balance as of September 6, 1938	$13.61
Fees Collected	8.00
Balance as of September 18, 1939	$21.61

REPORT ON SCHOOLS FOR OPERATORS ACCOUNT

Balance as of September 6, 1938	$25.00
To A. P. Banta for Miscellaneous Expenses	25.00
Balance as of September 18, 1939	$ 0.00

Respectfully submitted,

R. R. Ribal,
Secretary-Treasurer.

REPORT OF THE AUDITING COMMITTEE

September 18, 1939

This is to certify that we the undersigned "Auditing Committee" have audited the books for the year 1939 and find the financial report as set up by Mr. R. R. Ribal, secretary and treasurer of the California Sewage Works Association to be in order and correct.

E. R. Waggoner
A. L. Frick, Jr.
B. D. Phelps

AMENDMENTS TO CONSTITUTION AND BY-LAWS CALIFORNIA SEWAGE WORKS ASSOCIATION

Amendments to the Constitution of the C. S. W. A.

Amend Article V by adding the clause "after notice of the proposed amendments shall have been mailed to each member in advance" so that the Article shall read as follows: "Amendments to the Constitution may be made by a two-thirds vote of the members at the annual meeting, after notice

of the proposed amendments shall have been mailed to each member in advance."

Amendments to the By-Laws of the C. S. W. A.

Amend Article I, Section 5, by omitting the words "for one year," by adding after the word "reinstated" the phrase "at any time within one year," by changing the words "Governing Board" to "Secretary-Treasurer," and by changing the words "all back" to "current," so that the Section shall read as follows: "Any member whose dues are in arrears shall be dropped from membership by the Secretary-Treasurer, provided that any member who has been dropped from membership for non-payment of dues may be reinstated at any time within one year by the Secretary-Treasurer upon payment of current dues."

Amend Article II, Section 1, by changing the words "delinquent on" to "in arrears" and "January" to "February" so that the Section shall read as follows: "Annual dues shall be two dollars, payable in advance on October first, to cover the succeeding fiscal year. Dues are in arrears on February 1st following the annual meeting."

Amend Article II, Section 3, by adding after the word "dollar" the words "and fifty cents" so that the Section shall read as follows: "Of the annual dues, one dollar and fifty cents shall be paid to the Federation of Sewage Works Associations for membership in the Federation and shall entitle the member to a copy of the Federation publications for the fiscal year covered."

Amend Article III, Section 1, by striking out the words "in good standing" and adding the words "persons holding individual memberships in the Association" so that the Section shall read as follows: "Officers of the Association shall be elected from persons holding individual memberships in the Association."

Amend Article III, Section 5, by adding at the beginning of the clause, "The First Vice-President shall succeed the President in case of a vacancy in the office, and other" so that the Section shall read as follows: "The First Vice-President shall succeed the President in case of a vacancy in the office, and other vacancies shall be filled by appointment by the Governing Board, appointees to hold office until the next annual meeting of the Association, at which time any unexpired term of office shall be filled at regular election."

Amend Article III, Section 9, by adding at the beginning of the clause, "It shall be the duty of," by changing the words "shall' in the first and second lines to "to," by striking out the word "annual" in the second line, by inserting before the first word "meetings" the phrase "of the Association" and by striking out the second word "meetings," so that the Section shall read as follows: "It shall be the duty of the Secretary-Treasurer to attend, and to record the proceedings of, all meetings of the Association and of the Governing Board. He shall also attend to the collection of all dues and money due the Association and shall prepare all claims against the Association for payment and shall pay the latter upon approval thereof by the President."

Amend Article III by adding a Section 11 reading as follows: "The Governing Board shall appoint two representatives of this Association to serve on the Board of Control of the Federation of Sewage Works Associa-

tions. Each representative shall serve for a period of two years with overlapping terms, one representative being appointed at each annual meeting to serve for the next two calendar years. Vacancies shall be filled by the Governing Board. Representatives on the Board of Control shall attend all meetings of the Governing Board, and participate in discussions, but without the right to vote."

Amend Article IV, Section 1, by striking out the words "not less than three months prior to the meeting" so that the Section shall read as follows: "There shall be an annual meeting of the Association, the time, place and duration to be determined by the Governing Board."

Amend Article IV, Section 2, by adding at the beginning the words "Spring Conferences and," so that the Section shall read as follows: "Spring Conferences and special meetings may be held at such times and places as may be determined by the Governing Board."

Amend Article IV, Section 3, by changing the words "Thirty days" to "Ample," so that the Section shall read as follows: "Ample notice of all meetings shall be given each member by mail."

Amend Article IV by adding a new Section 4 reading as follows: "A registration fee of twenty-five cents, when declared necessary by the Governing Board, shall be collected at the Fall Convention and Spring Conference."

Insert a new "Article V, Local Sections," reading as follows: "Section 1. An area group may form a Section of this Association, subject to the approval of the Governing Board, and its name shall indicate such affiliation. Application for the formation of a Section, with its proposed name and area, accompanied by a copy of its proposed Constitution and By-Laws, shall be filed with the Secretary-Treasurer of the Association at least sixty days before the annual meeting and copies thereof shall be transmitted by him to members of the Governing Board. Action of the Governing Board upon the application shall be taken at the next annual meeting.

Section 2. Membership in a Local Section shall be limited to members of the Association who are located within the Section area. No member shall be enrolled in more than one Section.

Section 3. Dues may be fixed by each Section which shall not include membership dues in the Association.

Section 4. Each Section shall have at least one officer known as the Section Secretary-Treasurer. Prior to the annual meeting of the Association he shall submit to the Secretary-Treasurer of the Association a report of the membership, activities and finances of the Section.

Section 5. Each Section shall conduct its meetings and regulate its business in a manner consistent with the objects and policies of the Association."

Amend Article V by changing its number to "VI," and adding the phrase "after notice of the proposed amendments shall have been mailed to each member in advance," so that the Article VI shall read as follows: "Amendments to the By-Laws may be made by a two-thirds vote of the members at the annual meeting, after notice of the proposed amendments shall have been mailed to each member in advance."

Approved in Convention Assembled, Oakland, California, Sept. 18, 1939.

R. R. Ribal,

Secretary-Treasurer.

REPORT OF THE SECRETARY-TREASURER
SAN JOAQUIN SECTION
CALIFORNIA SEWAGE WORKS ASSOCIATION

In accordance with the provisions of the Constitution and By-Laws of the San Joaquin Section of the California Sewage Works Association, I herewith beg to submit a report of the membership activities and finances of the Section. Membership consists of 15 paid up members. As you know, this past year the San Joaquin Section undertook responsibility of collecting the $2.00 dues in the California Sewage Works Association as well as its own Section dues. Consequently, I record as of the present date the following financial statement:

Balance on hand, 10-7-'38	$ 4.25	
Income from dues	34.00	
		$38.25
Disbursements and payments of		
C. S. W. A. dues	$30.00	
Stationery	5.50	
		$35.50
Balance on hand, 9-14-'39		$ 2.75

With regard to activities, the San Joaquin Section has held a meeting each month, with a variety of programs, including visits to sewage treatment plants, and addresses by a number of out-of-town speakers on subjects pertinent to sewage treatment. The policy of the Section has been to hold meetings at the various towns within the Section in rotation. Meetings have been held during the year at Stockton, Lodi, Manteca, Tracy and Turlock.

REPORT OF COMMITTEE ON
CERTIFICATION OF SEWAGE PLANT OPERATORS
1939

This committee has issued six Grade III Certificates to operators from Southern California. One application from Northern California was considered and rejected. There is one application under consideration.

Respectfully submitted,

A. Perry Banta,

Chairman.

REPORT OF COMMITTEE ON SCHOOLS FOR SEWAGE PLANT OPERATORS 1939

The activity of this committee consisted in holding a five day short course for sewage plant operators at the University of Southern California. This school was held June 12-16, 1939, in cooperation with the California section of the American Water Works Association.

The course was attended by about twelve regular plant operators, although there were as high as eighty in attendance at the joint sessions. The average attendance at the regular sewage sessions was twenty-one.

The short course was conducted at a net expense to the Association of $3.35. A detailed financial statement is appended hereto.

The Association is indebted to a long list of people who have participated in making this short course a success. I personally wish to express my thanks to the committed members: Messrs. H. O. Banks, R. L. Derby, H. F. Gray, and Dr. R. Pomeroy. Through their efforts the job of putting on this short course was made easy.

Respectfully submitted,

A. Perry Banta,

Chairman.

FINANCIAL STATEMENT

Committee on Schools for Sewage Plant Operators 1939

RECEIPTS:

From C. S. W. A.	$25.00
From A. W. W. A.	25.00
Sale of Notes	70.10
Grant from U. S. C.	28.00
Total	$148.10

DISBURSEMENTS:

Printing Notes	$98.10
Typing, Messenger, Miscellaneous	6.70
Refund C. S. W. A.	21.65
Refund A. W. W. A.	21.65
Total	$148.10

THE COMMITTEE ON AWARD REPORT AND RECOMMENDATION ON THE AWARD OF MERIT

To the Members of the California Sewage Works Association:

The Committee on Award begs to submit its Report and Recommendations concerning the Award of Merit for the year 1939.

In April, 1939, the Committee on Award prepared a Circular Letter concerning the Award of Merit of the California Sewage Works Association for the year 1939 and a Form of Declaration of Entrance of sewage treatment plants in competition for the Award. Early in June the Circular Letter and the Form of Declaration were mailed by the secretary of the Association to all clerks of communities in the State which were operating sewage treatment plants, to all secretaries of Sanitary Districts, to all Certified Sewage Works Operators and to all City Engineers.

In response to the Circular Letter, ten (10) Declarations of Entrance were returned. One City responded, saying that they did not wish to compete and one thanked us for the invitation, but could not compete because, as yet, did not have a treatment plant. To each of the ten that responded a letter of acknowledgment and a suggested outline for a brief report, was sent. Five (5) reports were returned.

Consideration was therefore given by the Committee to the relative and absolute merits of the five plants for which all the terms of the competition as laid down by Committee had been fulfilled.

RECOMMENDATIONS

Holding in review the various factors and conditions which, in the opinion of this Committee, should be recognized as having their due effect upon the proper determination of merit as related to the Award, it is recommended:

(1) That the Award of Merit for the Year 1939 be made to the City of Santa Clara.

(2) That the Second Award be made to the City of Lodi.

(3) That the Third Award should not be made.

(4) That the Cities of Burlingame, Laguna Beach and Whittier be thanked for their efforts.

The Committee expresses the hope that the plants not winning the Award this year shall strive for the Award of next year.

Respectfully submitted,

HAROLD L. MAY,

Chairman.

In Memory

It is with a sense of loss that we announce the passing of:

Mr. Edward Qualls, June 3, 1938. Mr. Qualls met with death in an automobile accident. He had been operating the Whittier plant for 7 years and had held a Grade 2 operator's license since July, 1937.

Augustus L. Gladding, August 7, 1939. Mr. Gladding died after a nine-months illness caused by a heart attack in November, 1938. Mr. Gladding was a native Californian and followed a long line of persons in the Clay Products business. As a Ceramic Engineer, he first associated with Gladding, McBean & Company. Later he became Secretary and Vice-President. After 1931 he was associated with his brothers in the Clay Products business at San Jose. Mr .Gladding had been a member and staunch supporter of the Association since 1929.

Mr. Howard Vernon, October 15, 1939. Mr. Vernon died suddenly after returning home from a week-end of fishing. Members of the Association best knew Mr. Vernon for his activities to protect the sport of fishing. Mr. Vernon was a Court Reporter by occupation, but his interests led to membership in the Association in 1938. He had presented a paper to the Association just a month prior to his death.

Mr. Fred A. West, October 26, 1939. Mr. West suffered a heart attack the evening of October 25 and passed away later that night. Mr. West was a descendant of one of California's old Spanish families. He had worked for the City of Stockton thirty-three years. As sewage Plant Operator, he operated the Old Steam Plant in 1906; and the South Disposal Plant after 1921. Mr. West was a charter member of the California Sewage Works Association and held a Grade 2 operator's license.

Mr. Charles David Marx, December 31, 1939. "Daddy" Marx, as hundreds of Stanford students and many of his associates knew him, passed away after two years of failing health. "Daddy" Marx celebrated his 82nd birthday October 10. Truly a remarkable man, his many achievements have made history in many fields of engineering. As acting President of Stanford University six years; Chairman of the Board of Public Works, City of Palo Alto, twenty-four years; Chairman, Stanford Engineering Commission for repair and reconstruction of the 1906 earthquake; Chairman, First State Water Commission of California; Chairman, Arch Dam Committee of Engineering Foundation; and member of many engineering boards and commissions, he brought honor to his name and credit to his profession. Daddy Marx was President of the American Society of Civil Engineers in 1915 and had been elected an honorary member in 1927. He was a factor in the formation of the California Sewage Works Association and remained a member until ill health forced his retirement in 1938.

PROBLEMS IN THE OPERATION OF THE RICHMOND-SUNSET SEWAGE TREATMENT PLANT

By **B. BENAS,** ***Superintendent***

Previous to the improvements made under the 1933 Sewer Bonds unsanitary conditions existed along the bay and ocean shores, as evidenced by pollution on the shores, the appearance of sewage fields off shore and the results of bacterial tests. This pollution was due to the discharge of untreated sewage from a number of outlets at the shore, which pollution was carried back and forth by the tides, resulting in unsanitary conditions along the shore waters.

The Bureau of Engineering recognized this condition and had for a number of years made preliminary studies but no funds were available to make complete studies or to formulate definite programs of which construction would be a part. Accordingly, when the funds became available under the 1933 Sewer Bonds, a board of consulting sanitary engineers consisting of the late Harrison P. Eddy of Boston, Professor Charles Gilman Hyde of the University of California, Mr. Clyde C. Kennedy of San Francisco and Professor Leon B. Reynolds of Stanford University was appointed to make the necessary studies and recommendations. This board reported in May, 1935, substantially as follows:

> That the number of outlets discharging sanitary sewage in the bay be reduced and that the sewage of the various districts be combined for treatment and disposal so that no untreated sewage would be discharged at any point along the bay or ocean fronts.
>
> In order to accomplish this it was recommended that sewage from the districts in the southeast portion of the city be treated at treatment plants located at Visitacion Valley and Hunters Point, and that sewage of the main portion of the easterly slope comprising the North Point and Marina districts be treated at a plant to be located at North Point, and that the treated sewage be discharged approximately 2000 feet off shore in 60-ft. depth of water; that the Marina Pumping Plant and force main be constructed to pump the sewage from the Marina district to North Point; that the sewage of the westerly slope of the city, comprising the Baker's Beach or East Richmond district, West Richmond and Sunset districts be conveyed to and treated at the Richmond-Sunset Sewage Treatment Plant to be located in the southwest portion of Golden Gate Park; that as much as needed of the effluent be furnished for use in the park, and that the remainder be discharged into the existing Mile Rock trunk sewer to the present outlet at the north shore a short distance eastward of Lobos Point, and that the sludge be digested and dewatered on vacuum filters and furnished for use in the park, upon municipal golf courses and other areas.

It was not possible under the bond issue to complete the whole program, and as the north shore and Great Highway are the main recreational areas at present, works were constructed towards the improvement of these areas as follows:

The Marina Pumping Plant and discharge sewer which pumps the sewage from the Marina district to North Point was built, thereby eliminating the direct source of pollution at the Yacht Harbor. In addition, the United States Government made provision for and are constructing works to discharge the sewage from Fort Mason and the Presidio into the connecting sewers to the Marina Pumping Plant.

The Richmond sewer tunnel and the Richmond connecting sewer which carry the sewage from the Baker's Beach and West Richmond districts to the Richmond-Sunset Sewage Treatment Plant, and the plant itself were constructed, thereby eliminating the direct pollution caused by the discharge of untreated sewage at the Baker's Beach and Mile Rock outfalls.

For the Richmond-Sunset Sewage Treatment Plant studies were made of the population, flows and sewage characteristics for the tributary area. These studies showed that there was a population of 130,000 in the 1930 census, which would increase to 310,000 as an ultimate figure, and that the average flow for the West Richmond and Sunset districts was approximately 60 gallons per capita per day and somewhat higher in the Baker's Beach district. The flows varied throughout the day, with a maximum of 1.6 times the average and a minimum of approximately .25 of the average. The tests indicated that the sewage would have an average strength of approximately 360 p.p.m. suspended solids and that the volatile matter was approximately 80% of the suspended solids.

The plant was originally designed for a flow of 15 m.g.d. corresponding to a tributary population of 200,000, with provision for additional units to double this capacity when and if required due to the increase of population and flow.

In determining the degree of treatment required, it was necessary to take into consideration the diluting value of the ocean waters into which the sewage was discharged. Accordingly, the plant was designed to remove large floating material, grit and grease, and suspended solids, and for the addition of chlorine for odor control and bacterial disinfection during the time when the beaches are in use, and for digestion of the screenings, grease, scum and sludge, and elutriation and filtration of the digested sludge.

The treated effluent is discharged to the Mile Rock sewer and the filtered sludge given to the park to be used as fertilizer. No provision was made in the original plant layout for an activated sludge plant to treat some of the effluent for park purposes, or for a dehydrator plant to dry the sludge from approximately 75% as it discharges from the vacuum filter to approximately 5 to 10% moisture content.

The design of the plant for 15 m.g.d. capacity called for four grit-grease tanks, four mixing and sedimentation tanks, two vacuum filters, and a multi-stage digestion system, but it was necessary to eliminate two grit-grease tanks, two mixing and sedimentation tanks, one vacuum filter, and the secondary digester of the multi-stage digestion system due to lack of funds.

The plant provides for the following:

(a) Measurement of incoming flow by three-function water level recorders off of 3′ venturi flumes.

(b) Removal of floating material by hand cleaned bar racks, 4″ opening, and mechanically cleaned bar racks, ¾″ opening, the screenings being dumped into screening buggies, transported by hand to the sludge control house, ground by a screenings grinder and deposited into the sludge thickening tanks.

(c) Removal of grit and grease in aerated Imhoff type tanks, 12′ wide by 50′ long, 10-minute holding time at average flow, the grease being carried to the inlet end of the tank by water sprays to a movable trough to a sump and pumped to the sludge thickening tanks in the Sludge Control House. The sand is carried to the inlet end of the tanks by grit collectors and pumped to a sand washer and the washed sand discharged into a hopper from whence it is loaded in a truck and then deposited in the Park. The organic return from the sand washer discharges into the influent channel to the tanks.

(d) Mixing of the effluent from the grit-grease tanks by horizontal mechanical flocculators, 33′6″ x 33′6″ x 10′ water depth divided into four bays without the use of chemicals, 30-minute holding time for the average flow, and plain sedimentation of the mixed sewage in rectangular tanks 33′6″ x 100′0″ x 10′ water depth, one and one-half hour holding time for the average flow, and discharging of the effluent over four slotted troughs, and with provision for by-passing of the mixing tanks or the use of one or two mixing tanks with one or two sedimentation tanks. The scum is removed by water sprays to the inlet end of the sedimentation tanks to a movable trough to the sludge thickening tanks. The sludge is removed from a deep sump at the inlet end of the sedimentation tanks to the sludge thickening tanks either through sight feeds or directly to the tanks or to the sludge pumps.

(e) Thickening of the combined ground screenings, grease and sludge in one of two tanks, capacity 17,500 gallons each, the supernatant being returned to the influent channel to the mixing tanks and the thickened sludge pumped to the digester.

(f) Chlorination of the raw sewage ahead of the plant for odor control and to the final effluent for bacterial disinfection during the time when the beaches are in use by vacuum type automatic chlorinators, both feeds being automatically controlled by controverters set in stilling wells off of the influent and effluent measuring flumes.

(g) Digestion of the sludge in the 80′ diameter by 30′ sludge depth primary unit of a two-stage sludge digestion process with turbo mixers, heating coils and stationary steel dome.

(h) Elutriation of the digested sludge in two rectangular tanks, approximately 14′6″ x 50′ x 9′ water depth, using the Genter Counter-Current Elutriation System, holding time of each tank two hours based on a flow of 400 gallons per minute total sludge and elutriating water, together with necessary mixing tanks, sludge pump, meters, etc.

(i) Filtration of the elutriated sludge by a vacuum filter, 200 square feet filter area, with bucket elevator feed for the sludge, feeding of ferric chloride in proportion to the feed of the bucket elevator, conditioning of the treated sludge, and automatic regulation of the conditioned sludge feed to the filter.

(j) Handling of the filtered sludge by a 24″ horizontal rubber belt conveyor feeding to a 24″ inclined troughing rubber belt conveyor to a 24″ horizontal rubber shuttle belt conveyor discharging into hoppers holding approximately six yards each.

(k) Pumping of the Sunset sewage in the Sunset pumping station by one sewage pump, maximum capacity 800 G.P.M., single speed, 850 R.P.M., and two sewage pumps maximum capacity each 4000 G.P.M., two speeds, 695 and 870 R.P.M., with control of incoming flows by a basin level regulator and shut-off valve and measurement of pumped discharge by three-function recorder off of an orifice, and with special provision for collecting, pumping, washing and storing of the sand collected in the sump.

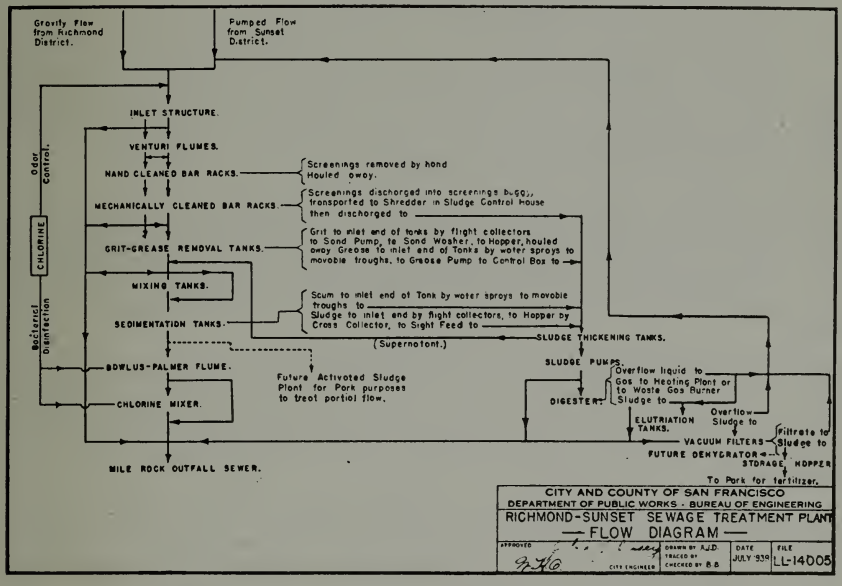
In addition, the plant provides for heating of the Digester and the Main Building by either sewer or natural gas, and contains a laboratory, storeroom, machine shop, shower and locker room, and office.

The plant consists essentially of the following units, the dimensions given being approximate:

Pre-Treatment Building—A two and three-story building 54′ x 120′ housing venturi flumes and recorders, bar racks, chlorine storage room and chlorinators, sand washer and sand storage hopper, grit and grease removal tanks, and equipment.

Sludge Control House—A two and three-story building 25′ x 40′ housing sludge thickening tanks, sludge handling equipment and shredder for screenings.

Mixing and Sedimentation Building—Covered tanks 70′ x 134′ with horizontal mixers, sedimentation tanks with collectors, scum removal equipment and return conduit for two-stage sedimentation.


Gravity Flow from Richmond District.
Pumped Flow from Sunset District.
INLET STRUCTURE.
VENTURI FLUMES.
Odor Control.
HAND CLEANED BAR RACKS.
Screenings removed by hand Hauled away.
MECHANICALLY CLEANED BAR RACKS.
Screenings discharged into screenings hopper, transported to Shredder in Sludge Control House then discharged to
CHLORINE
GRIT-GREASE REMOVAL TANKS.
Grit to inlet end of tanks by flight collectors to Sand Pump, to Sand Washer, to Hopper, hauled away Grease to inlet end of Tanks by water sprays to movable troughs, to Grease Pump to Control Box to
MIXING TANKS.
Bacterial Disinfection
SEDIMENTATION TANKS.
Scum to inlet end of Tank by water sprays to movable troughs to Sludge to inlet end by flight collectors, to Hopper by Cross Collector, to Sight Feed to
(Supernatant.)
SLUDGE THICKENING TANKS.
SLUDGE PUMPS.
BOWLUS-PALMER FLUME.
Future Activated Sludge Plant for Park purposes to treat portion flow.
DIGESTERS
Overflow liquid to Gas to Heating Plant or to Waste Gas Burner
Sludge to
ELUTRIATION TANKS.
Overflow Sludge to
Filtrate to Sludge to
VACUUM FILTERS
FUTURE DEHYDRATOR
STORAGE HOPPER
To Park for fertilizer.
CHLORINE MIXER.
MILE ROCK OUTFALL SEWER.
CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS - BUREAU OF ENGINEERING
RICHMOND-SUNSET SEWAGE TREATMENT PLANT
— FLOW DIAGRAM —
APPROVED
CITY ENGINEER
DRAWN BY A.J.D.
TRACED BY
CHECKED BY B.B.
DATE JULY 1939
FILE LL-14005

Primary Digester and Digester Operating House—A covered storage tank 80′ diameter by 30′ sides with a one-story house 20′ x 26′.

Main Building—Two and three-story building 67′ x 130′ housing elutriation mixers and tanks, vacuum filter, pumping station, main switchboard, heating plant, machine shop, storeroom, office and laboratory.

The plant was placed in operation in stages, the sewage from the Richmond District being first run through the bar racks and grit-grease tanks starting March 8th, and then through the bar racks, grit-grease tanks and sedimentation tanks to the Mile Rock outfall starting March 10th. Due to repairs to the concrete gate in the diversion structure, the sewage from the Sunset District was not pumped through the plant until April 19th.

Until March 19th the sludge from the sedimentation tanks was pumped directly to the Mile Rock sewer, and after that date to the digester. Prechlorination only was used until April 15th when post-chlorination was also added. The sludge from the digester was first drawn to the elutriation tanks on May 24th.

During the first six months of operation most of the plant functions have been operated continuously except for periods of shut-down for repair, cleaning and changes.

Many problems have arisen during this early operating period. We have attempted to obtain data as to the flow, sewage characteristics and as to the quantities of chemicals and sludge that have to be handled. In addition, some work has been done towards the study of the operating conditions to obtain the maximum efficiency of the equipment and of the processes.

For the purpose of this paper the operation of this plant has been divided into three main divisions:

1—The problems of control and regulation.
2—Laboratory tests and studies.
3—Operation.

Control of Flows—Control and knowledge of flows are essential to proper plant operation. In this plant part of the flow is from the Richmond District by gravity and part from the Sunset District by pumping from the Sunset Pumping Plant in the main building.

There are two diversion structures on the connecting sewer from the Richmond District where the flow from the combined sewer systems to the plant can be controlled or by-passed. A diversion gate on the Mile Rock sewer and inlet control valves on the inlet line from the Mile Rock sewer to the Sunset pump sump control the diversion or by-passing of the Sunset sewage.

The plant was designed to take care of the normal sanitary flow and light summer rains, it being necessary to by-pass the Sunset sewage during times of storm. Chemicals and treatment processes are regulated in accordance with flows so that the proper knowledge and control is of paramount importance.

It was proposed to tabulate and make studies of hourly, daily, and seasonal records to determine possible minimums, maximums and averages for present and future treatment; to determine relations between storm and sanitary flow and effect on hydraulic grade line through the plant; and to set up operating conditions for the use of one or two channels in the Pre-Treatment Building.

Our records to date show that the average daily flow varies from 6.5 to 8 M.G.D., being greater during the week days and less on Saturdays and Sundays. This daily average increases during the school period and decreases during the vacation period. We have not had any opportunity to determine what the winter flow will be but it is assumed that it will probably increase from 10 to 15% over the average summer flow.

There is considerable variation in the daily flow, a peak of approximately 1.75 times the average occurring from 9 to 10 A. M. on week days and from 10 to 12 A. M. on Sundays, and a minimum of approximately .25 of the average occurring at 5 to 6 A.M. There is an afternoon low at 5 P.M. which is slightly less than the average, and an evening peak at about 8 P.M. slightly above the average.

Bar Racks—The bar racks are used to remove large floating particles. On account of the sewage being from a combined system a hand cleaned bar

rack is placed ahead of the mechanically cleaned bar rack to remove particles which might interfere with the operation of the mechanically cleaned bar rack.

Except when the plant first went into operation, very little material has collected in the hand cleaned bar rack, with the exception of rags at times. However, we have not had any rains which might bring down considerable floating material. The bar racks have been operated continuously and we have removed approximately 3 cu. ft. of screenings per million gallons of sewage. No particular trouble has been experienced in the handling of the screenings by screening buggies, or in the transportation of the screenings to the Sludge Control House. At times the bar rack has been washed with chlorine solution and some solution added to the screenings for the control of odor.

Grit and Grease Removal—It is necessary to remove grit as it deposits in the channels and affects the life of the mechanical equipment and interferes with the operation of the digester. The areas tributary to the plant have sand dunes composed of very fine sand, a large proportion being between 1/60 and 1/100 mm. in size. The sand handling problem in this plant is very acute and will be discussed more fully in the operation of the Sunset sump.

Grease increases the scum problem in the sedimentation tank and affects the appearance of the sewage fields off shore. It is essential to remove as much of this as possible, consistent with other operating factors.

In the operation of the grit-grease tanks a number of problems present themselves:

1. The determination of the correct location of the diffuser plate holders to give a transverse flow from flowing through chamber through wickets to the grease collecting chamber.
2. Determination of air requirements as affected by change in volume and strength of sewage to give maximum removal of free grease without liberating grease from suspended solids.
3. Determination of air requirements to give complete removal of sand with minimum removal of organic material.
4. Determination of operating conditions of the sand washer to give removal of sand of smallest size up to 1/100 mm.
5. Determination of best operating conditions for grease pumping and method and interval between cleaning of lines.

Tests were first made for the correct location of the diffuser plate holders and it was found that with one holder located next to the wall and the other with about 6 inches clearance from the first that there was the least tendency to circulate in the flowing through chamber only and that the holding time in the unit as tested by dyes corresponded to the theoretical holding time.

As will be discussed by Mr. Fraschina, grease removal tests are not always consistent, so that it has been hard to determine what results are being obtained from this unit. Some of the grease liberates in the inlet channel to the sedimentation tanks so that the efficiency can only be expressed in terms of overall removal rather than the removal at the surface of the tank.

No particular trouble has been experienced with the operation of the grease removal system except that at times it is necessary to supplement the water sprays by hand operation with a rake.

When the grease is skimmed off, the inlet valve to that tank is closed and the air supply cut down to a minimum so that the water comes practically to rest, thereby requiring the least force for the water sprays to move and grease to the inlet end. No trouble has been experienced in the pumping of the grease.

Tests were made of the air requirements and it was found that if the air was applied at the rate of .05 of a cu. ft. per gallon based on the average flow the maximum amount of sand was removed with a minimum of organic material. Some fine sand is carried beyond the tanks and collects in the inlet channel to the sedimentation building and in the mixing tanks. This bears some relation to the quantity being pumped over from the Sunset sump and decreases materially after the sump has been cleaned. Tests will be made to determine if this can be completely eliminated by placing another tank in service, thereby reducing the flowing through velocity by one-third.

The sand pump was originally installed with a 3 h.p. motor based on pumping a mixture of sand and water of approximately 75% moisture with a velocity of approximately 4.5 feet per second. Some trouble was experienced in the plugging of the discharge line when slugs of sand got into the pump. This unit has been replaced with a pump having a 5 h.p. motor, so that velocities up to 7 and 8 feet per second can be obtained. No further trouble has been experienced since the new installation.

The sand washer produces a reasonably clean and dry sand under normal operating conditions. However, during storm conditions or when the Sunset sump is being washed down, some organic material comes over with the washed sand. The quantity of washed sand varies, depending upon the operation of the Sunset sump, from one-half to three yards per day. This sand is delivered to the park and used for fill and for composting of sludge.

Mixing and Sedimentation—The sedimentation tanks remove the particles of suspended solids which will settle by gravity. In this plant mixing tanks with slow stirring have been added to increase the efficiency of sedimentation without the addition of chemicals. The inclusion of the mixing unit was based on the results of experiments made previous to the design of the plant which showed that it was possible to obtain considerably higher percentage removal of suspended solids with mixing than without and that the settling curve became much steeper and all of the material would settle, settling out in less than an hour. For the most efficient operation of the mixing and sedimentation tanks it was decided that the following tests would have to be made:

Mixing—1. Determination of the speed of the paddles for best flocculation through operation of variable speed drive.

2. Check on the holding time in baffled units and study for elimination of short-circuiting if required.

Sedimentation Tanks—1. Determination of best method of operation based on removal of suspended solids and B.O.D.

(a) Mixing—Sedimentation
(b) Mixing 1 tank—sedimentation 2 tanks
(c) Mixing—sedimentation—mixing—sedimentation

For each of the above the determination of the maximum flow possible for each process as related to effect on hydraulic grade line.

2. Check on operation of the flight conveyors and determination of time interval of operation through daily cycle.

3. Check on best pressure of nozzles for most efficient operation and spacing to move particles most efficiently to scum trough.

Tests made on the removal of suspended solids for various speeds of the paddle showed that best results were obtained at a speed of .8 ft. per second at the periphery, that nearly as good results were obtained at 1 ft. per second at the periphery, and that for higher speeds the percentage removal decreased. A speed of 1 ft. per second is now being used as there is less tendency to deposit material in the baffled mixing tanks.

Tests made with dyes show that there is practically no short-circuiting in the mixing tanks as baffled.

Due to other conditions we have run all the flow through the mixing tanks and sedimentation tanks in series. Attempts will be made in the future to check the operating using one mixing tank and two sedimentation tanks, and for two-stage treatment.

Our tests show that the overall removal of suspended solids is approximately 80% for a sewage with an average strength of approximately 350 parts per million suspended solids. This figure varies with the strength of the sewage and with the withdrawal of sludge from the sedimentation tanks. By continually withdrawing sludge, thereby preventing any accumulation in the sedimentation tanks, it is possible to obtain an effluent of not over 50 parts per million of suspended solids. However, this requires constant attention so that we have attempted to work out a withdrawal cycle based on the operators average time. It has been found that thicker sludge is obtained by operating the flight conveyors intermittently, one hour on and one hour off, rather than continuously.

On account of a break in the suction line, Park water was originally used for the water sprays in the sedimentation tanks, but now treated effluent is being used. The spray system works very satisfactorily and moves the scum to the trough at the inlet end to the tanks.

Sludge Control House—Two sludge thickening tanks, each with a capacity of 17,500 gallons, are located in the Sludge Control House, the purpose being to obtain a thicker sludge and to observe all operations before pumping to the digester. Ground screenings, grease and sludge fed through sight feeds are added to the thickening tanks.

During the first months of operation, due to certain operating difficulties, it was not possible to get a thick sludge. These conditions have been changed and the average moisture content of the sludge now being pumped to the digester is approximately 95 to 95.5%.

Before obtaining the most efficient operation it was necessary to make studies of the following problems:

1. Determine whether grease and ground screenings can be added first and then sludge, or whether on top of sludge, by study of surface scum.

2. Make moisture determinations of sludge to determine time concentration to reduce moisture to point desired.

3. Study head losses in discharge pipe by means of pressure and volume readings to determine lowest moisture content sludge that can be pumped with available equipment.

4. Determine effect of chlorine addition on scum and odor.

5. Determine time operation cycle of sludge removal, whether continuous or intermittent, and, if intermittent, time variation with relation to strength of sewage.

6. Determine shut-off elevation in sump through operation of pressure operated mercoid switch.

It was found that a holding time of at least an hour and one-half is required for the sludge to thicken and that with this holding time approximately 50% of the sludge drawn off from the clarifiers is turned back as supernatant, depending upon the moisture content of the sludge withdrawn. If an attempt was made to so control the draw-off from the sedimentation tanks to cut down on the amount of sludge, the result would be increased time required for operation and a poorer effluent.

No particular trouble has been experienced with odors in the Sludge Control House. Chlorine solution is added to the screenings before grinding, thereby eliminating the major portion of the odor from this source. No chlorine solution is added to the surface of the sludge in the sludge thickening tanks.

Chlorination—Chlorine is added to the sewage before reaching the plant in proportion to the flow for odor control and to the effluent leaving the plant in proportion to the flow for bacterial disinfection. The operation of the chlorinators and the regulation of the dosage for best results requires supervision and study. In order to get the most efficient operation the following studies have to be made:

a. Determination of hourly, daily, weekly and seasonal variation of strength and flow of sewage to give a pound rate curve. This curve will show the time when adjustment of chlorinator feed is required.

b. Determine P.P.M. dose for odor control as related to total demand.

c. Determine effect on total demand by increasing pre-chlorination dose.

d. Determine percentage variation in grease removal by varying chlorine dose.

e. Determine minimum required chlorine dose for post-chlorination to effect protection of beaches from B. Coli contamination.

It has not been possible to make all the studies outlined. For pre-chlorination we have found that it is necessary to use a dosage of at least 30 lbs. per million gallons to prevent odors. Chlorine for post-chlorination has been fed at the rate of 60 lbs. per million gallons during the period from 8 A. M. to 12 P. M., and 30 lbs. per million gallons from 12 P. M. to 8 A. M. It is not always possible to obtain a chlorine residual for the plant effluent as the strength of the sewage varies considerably throughout the day. Further tests are to be made correlating the chlorine demand, chlorine residual and strength of the sewage.

Sludge Digestion—The digester reduces the organic material which would break down, resulting in odors, to a point where the sludge can be disposed of without nuisance or odor. This results in the liberation of gas, release of water and reduction in volume and moisture content. It is necessary to so control digestion that the pH of the digester is about neutral, or above, that the gas will be mainly methane and have practically no hydrogen sulphide.

This requires constant check of pH, gas analysis, composition and moisture content of sludge and constant check of volume and temperature of recircu-

lated water; time regulation of additions and withdrawals to prevent too violent gas formations; and regulation and control of time of operation of motor operated impellers.

The digester was first filled with raw sewage, the temperature increased to 85° F. and the sludge added. Some lime was added with the original sludge. The pH of the digester originally dropped to 6.7 and when no further lime was added dropped to 5.3. As the pH did not increase, lime was added one month after the digester went into operation and the pH raised to 6.7. Since that time the digester has maintained a pH of approximately 6.9 to 7.1 without the addition of any more lime. After about one and one-half months of operation the volatile matter in the digester changed from an incoming sludge of 80 to the digested sludge of approximately 70, showing a reduction in volatile material of 42%. This figure was maintained for about a month, being slightly less at times. After about two and one-half months of operation the reduction in volatile matter increased to approximately 50% and has been between 50 and 55 since that time.

The moisture content of the sludge in the digester at the top and at the bottom varies considerably depending upon a number of factors:

1. The temperature of the digester.
2. The rate of gas production.
3. The amount of withdrawal of digested sludge.

We have not been able to obtain a thick sludge in the digester as yet. This is due partially to the short holding time, the original design calling for two tanks, whereas only one has been constructed. If sufficient sludge is not withdrawn from the digester to the vacuum filter system, the supernatant overflow returning to the plant causes operating difficulties in the sedimentation tanks, increasing the amount of sludge required to be removed in order to maintain an effluent of good quality. We think our troubles in this respect would be eliminated by the addition of the secondary digester.

Elutriation and Sludge Filtration—It has been determined that by washing of the soluble ammoniacal compounds the amount of conditioning chemicals required for vacuum filtration can be kept at a minimum. Accordingly, the Genter Elutriation System was installed in this plant, the treated effluent being used for the wash water and the dirty water returned to the Sunset Pumping Plant to be recirculated through the system.

For most efficient operation it is necessary to:

1. Determine the relation between wash water and sludge, the speed and time of operation of the mixing units and the time of operation of the flight conveyors.
2. Make constant tests of elutriated material.
3. Determine the strength for most efficient feed of the feeder operated off of the drive of the sludge hoist.
4. Adjust the speed of the bucket elevator by varispeed control to give required amount of feed to the electrically driven sludge mixer and determine proper time of mixing to give most efficient filtration.

The ferric chloride used for conditioning of the sludge comes as a 45% anhydrous solution. This has to be diluted for daily use to approximately 10%.

We have made a number of studies on the proper operation of the elutriation and vacuum filter system. When the sludge was first drawn from

the digester and washed it was possible to obtain good filtration using approximately 1.5% ferric chloride based on a sludge of approximately 95 to 96% moisture content. After the system got into regular operation, the amount of ferric chloride required increased to approximately 4% for sludge of approximately 97.5% moisture content, at filtering rates of about 3.5 to 4 lbs. per square foot of filter area per hour.

A number of laboratory tests were made based on different quantities of wash water at different times and speeds of mixing. These tests showed that with two washings of approximately 3 to 1 wash water and for mixing just to the point where a heavy floc occurred that it was possible in the laboratory to get results using less than 2% ferric chloride and that as agitation was prolonged the floc was broken up and the time of filtration increased. Accordingly experiments were conducted in the conditioning tank ahead of the vacuum filter for different points of application of the ferric chloride giving different holding times. Based on our work to date it has been found that if the ferric chloride is added to the sludge as it enters the inlet pipe to the vacuum filter without any stirring that best results are obtained and that quantities of chemicals required approximate the laboratory tests. If the sludge becomes thin, that is of a moisture content of more than 97.5%, the ferric chloride requirements increase. Further tests are to be conducted to substantiate these conclusions and for improvement of operating conditions.

Sunset Pumping Station— As stated, the flow from the Mile Rock sewer from the Sunset District is diverted by a movable dam operated by an automatic gate raising device in the Mile Rock sewer to the Sunset sump. In the design of the plant provision was made for a scraper in the sump to scrape the sand to a pit and for a pump to pump the sand to a sand washer discharging onto a belt conveyor to a hopper. This installation was made with full knowledge that it might not be adequate to handle the sand and that additions and changes might have to be made if required.

The quantity of sand brought in by the Sunset sewage was so great, at times approximately 10 cu. yards per day, that the existing equipment did not function properly. Accordingly a new layout has been made which embodies provision for carrying the sand to a trough, agitation of the sand in the sump, and a pump to maintain velocities of at least 8 feet per second, which installation has not been made as yet. Until this installation is made, sand will continue to accumulate in the sump and have to be pumped periodically to the sewer.

Conclusions—Although there are a number of problems yet to be solved, we feel that the operation to date has been satisfactory and is substantially in accordance with the proposed design.

LABORATORY—THE RICHMOD-SUNSET PLANT

By **K. FRASCHINA,** ***Assistant Superintendent and Technician***

The purpose of the laboratory is three-fold:

1. To obtain data on plant operation for record and control.
2. To attempt to improve the operation of each unit for maximum efficiency.
3. To do such research work as is necessary for information on the

design of future additions to the plant and for any new plants that may be constructed.

Daily tests are made of the strength of the raw sewage and plant effluent in suspended solids, percent moisture and volatile matter of sludge pumped to the digester, pH, percent moisture and volatile matter of sludge at the top and bottom of the digester, strength of ferric chloride used as a sludge conditioner, and percent moisture and volatile matter of the elutriated and filtered sludge. In addition, analyses are made periodically of the sludge gas, of the chlorine demands and residuals, and of grease content of the raw and final effluent.

These tests serve as indicators of plant operation and the operation is adjusted in accordance with the results obtained. A higher effluent indicates that supernatant is coming over from the digester or that sufficient sludge is not bing drawn from the sedimentation tanks.

Moisture content of the thickened sludge gives a clue as to whether the settling period is sufficient or whether enough supernatant is being returned to the system.

The tests for the digester indicate whether this unit should be rested or not and as to whether sludge should be withdrawn.

Tests of the elutriated and filtered sludge and the quantity of ferric chloride used give data as to the results and efficiency of these processes.

Considerable work has been done towards finding a simple method for the determination of suspended solids and the Chicago Sanitary District method using a Buckner funnel and filter paper has been decided on as being the most satisfactory for our purpose.

Our tests have shown that this method is simpler and gives much more reproducible results than the gooch crucible method. Our tests have also shown that 24-hour composite samples for suspended solids on either the raw sewage or plant effluent give very erratic results, the suspended solids increasing for the first two or three hours and then decreasing thereafter. The present procedure is to run the suspended solids on the raw sewage and plant effluent at 8-hour intervals during the day, changing the time each week so that an average curve can be drawn for a month for both the raw sewage and plant effluent. From this curve we can go back and compute the weighted average suspended solids for each day, using the individual suspended solid values and the flows at the time. In this way it is possible to get a closer approximation to the actual suspended solids in the sewage than can be obtained with a 24-hour composite sample.

It is difficult to get representative samples of the effluent from the grit-grease tanks and we have not been able to determine as yet the efficiency of the grease removal of the tank as a unit but must report the grease removal as a whole, as Mr. Benas has previously stated.

In addition, laboratory work is being done with several methods of grease determination using various solvents to see which method gives the best results.

Considerable work has been done in an attempt to correlate the chlorine demand of the plant effluent as determined in the laboratory with actual residuals obtained in plant operation.

Rather extensive elutriation tests have been run in the laboratory, using

various wash water ratios on digested sludge and plant elutriated sludge to determine the optimum ferric chloride dosage and the best mixing conditions. Based on the time of vacuum break, the tests indicated that we could satisfactorily filter sludge using less ferric chloride than was being used on the vacuum filter. Accordingly experiments were conducted with various mixing conditions in the conditioner of the vacuum filter and results have been obtained comparable with the laboratory findings. Computations on sludge solids and water filtered in the vacuum filter indicated that the vacuum filter can only do so much work in removing water from the sludge. Based on these results changes were made in the piping of the vacuum filter system which improved the operation.

Daily laboratory results are recorded on tabular forms so designed that the changes and operations of the plant can be detected easily. These records are not only useful for the control of the operation of the plant but also serve as a permanent record for future reference.

Simple tests have been devised wherever possible to assist the operators in the operation of various processes. For instance, the control of ferric chloride feed for conditioning of the sludge to the vacuum filter is by a vacuum break test which is made by the filter operator.

The laboratory results obtained are limited by the extent by which the samples are representative. A special effort has been made to devise sampling schedules so that the best representative samples are obtained without undue interference with other plant duties of the attendants.

A brief description of some of the laboratory work has been given. This brings out the fact that without definite knowledge of what is taking place it is impossible to get the most out of a plant.

PERSONNEL AND OPERATION—THE RICHMOND-SUNSET PLANT

By R. SOTTER, *Chief Operating Engineer*

The operating personnel consists of five stationary steam engineers who serve as shift operators and do maintenance work; four sewage pumping station attendants who serve under the operators on shift and assist in maintenance; two laborers and one truck driver.

We were particularly fortunate in obtaining men for the above classifications who have had considerable experience and were able to easily adapt themselves to the operation of the equipment and processes and do maintenance and repair work. In determining an operation schedule an attempt has been made to rotate the men so that all would become acquainted with all of the equipment and processes.

The operating schedule is laid out so that a shift operator and attendant are on duty three shifts a day, that a vacuum filter operator, who is a stationary steam engineer, is on duty from Monday through Saturday, and that a maintenance man, who is a stationary steam engineer, and an assistant, who is a sewage pumping station attendant, are on duty from Tuesday through Thursday. The laborers and truck driver work from Monday through Friday.

In order to obtain operating data log schedules of operation have been set up and daily record forms are kept. Some changes had to be made from the original and we will shortly have complete forms for all of the plant. These cover the operation of the Pre-Treatment Building, Mixing and Sedimentation Building, Main Building and Digester, and are made out by the attendant or the operator on shift.

For the Pre-Treatment Building information is recorded as to the bar rack operation, amount and time of screenings haulage, rate of pre- and post-chlorination feed, blower operation, and general remarks.

For the Sludge Control House and Mixing and Sedimentation Building, information is recorded on shredder operation, sludge pump operation, time of withdrawal from the sedimentation tanks, quantity of sludge pumped to the digester and supernatant return to the system, operation of the mixing and sedimentation tanks and general remarks.

For the Main Building, information is recorded on the operation of the sewage pumps, the elutriation system, vacuum filter system, boiler room and sludge and sand haulage.

For the Digester information is recorded as to the temperature, amount and temperature of recirculating water, sludge pumped to and withdrawn from, and quantities of gas to the boiler and waste gas burner.

We have attempted in the first months of operation not only to keep the plant running but to try out the equipment under limiting conditions to determine any defects, as the contractor has put up an equipment bond for one year. A number of defects have been found which were repaired or replaced by the manufacturers.

Particular attention has been paid to lubrication and packing. The manufacturers have been consulted, and in most cases their recommendations followed. Charts have been made showing when each piece of equipment should be lubricated and the kind of lubrication to be used.

Pumps and all mechanical equipment are given periodic inspections dependent upon their service.

A special problem has presented itself in the operation of the electrical motors, especially in the Pre-Treatment and Mixing and Sedimentation Buildings. Due to damp conditions and the intermittent operation, some of the motors developed heavy grounds. These motors were removed, the stators baked for 48 hours and dipped in hot insulating varnish. So far the motors have tested out clear.

In the design of the plant electric controls were furnished at various locations and alarms indicating limiting conditions. These have proven very satisfactory and have been of great assistance.

The location of the plant just off of the ocean is conducive of corrosive atmospheric conditions which affect metal so that it is necessary to do considerable painting. The life of the paint coat is dependent upon the method of application, and it is necessary to see that the metal is clean before applying the paint. Proper ventilation, which helps to keep the atmosphere dry, has been a great aid in preventing corrosion in a number of locations.

The gas obtained from the Digester has been used in the boilers after the carbon dioxide content became less than 35%. This gas burns with a clear flame with practically no soot. Some trouble was experienced with the oper-

ation of the gas meters due to accumulation of water, the meters serving as traps, which trouble has been eliminated by installing special traps and connections for draining.

Special attention is given in handling sludge in pipe lines, frequent tests being made to see that the lines are clear by flushing.

Another part of the plant is the machine shop. A vise, cutting and welding outfit, drill press, grinder, dies and other tools have been provided to make repairs. These have been a great aid in keeping the plant in operation and preventing delays.

In addition to normal stocks, we are endeavoring to build up a supply of repair parts which are considered essential, especially for that equipment for which it is not possible to obtain parts locally. A number of delays would have been prevented if such a stock were on hand.

In closing, I want to stress four considerations for which we are particularly fortunate:

1. The fact that we have first class standard equipment of responsible manufacturers with available service.

2. A layout of plant and equipment which provides for ample working space for removal, repairs, adjustments and changes.

3. Adequate provision for water at convenient locations.

4. Adequate lighting.

Discussion:

Mr. C. G. Hyde:

The instructive papers to which we have just listened testify to the extraordinary importance of competent management and operation of sewage treatment plants. The putting into service of any new plant, even if of comparatively simple sort, should be considered to be an adventure calling for imagination and the willingness to try different methods of procedure, as well as for good fundamental knowledge coupled with plenty of energy.

The papers have shown that the laboratory is an indispensable factor in plant operation. It is the most dependable means, and sometimes the only means, by which the true value and efficiency of different methods of operation of any or all of the units of a plant can be demonstrated. Even at the smallest plants some laboratory determinations are important, although altogether too often not provided for or made.

The modern sewage treatment plant tends to become more and more highly mechanized as its size increases. The numbers and kinds of mechanisms involved are bewildering to the layman. He often finds it difficult to think of sewage treatment in terms of an industrial plant or factory. Yet such is increasingly the case. Possibly the present practice leans too heavily in that direction. In any event a mechanized plant cannot function unless its mechanisms are all in adjustment and good working order. This requires, in small plants, adequate mechanical skill on the part of the operator and, in large plants, expert supervision of skilled labor.

The Richmond-Sunset Plant is most fortunate in having all of these services in eminent degree. Its continuously improved performance must be attributed to constantly improved procedures, many of which were not manifest at the beginning of operations. This improved procedure has been discovered only through a great deal of experimentation.

There are numerous features of the Richmond-Sunset Plant which are of interest to the members of this Association. Although time is lacking in which

to discuss them at this time it is hoped that their enumeration will stimulate discussion either in written form in connection with the papers just presented; or orally or in writing in connection with some future meeting.

What has been the experience of the members of this Association with reference to the following:

(1) Prechlorination of raw sewage in reducing odors and possibly improving the performance of pre-treatment plants as related to grease removal and effluent disinfection; what have been the places and methods of application?

(2) (a) Improved Parshall flumes; (b) Palmer-Bowlus flumes; (c) Venturi pipe meters; in measuring raw sewage.

(3) (a), (b), and (c) as is (2) together with (d) rotary vane meters of the Sparling type; and (e) other measuring apparatus or methods; in measuring plain settled sewage or effluents of trickling filter and activated sludge treatment plants.

(4) Straight-line rate of flow charts with uniform scales for rate and time, respectively, rather than circular charts with non-uniform scales for both rate and time.

(5) Manually-cleaned coarse bar racks in advance of mechanically cleaned racks: how necessary or valuable.

(6) Most rational spacing of bars in mechanically cleaned racks to capitalize the fact of automatic cleaning.

(7) Disintegration or grinding of bar screenings prior to discharge with raw settled sludge into separate digestion tanks: is it worth the trouble and cost?

(8) Grit washers in sewage treatment plants: of what types and how efficient?

(9) Rectangular conduits for the conveyance of raw sewage; value of air and water sprays or other means of preventing deposits of sludge and grit therein.

(10) The use of air, experimentally or practically, in the removal of oil, grease and scum from raw sewage.

(11) The use of dry chlorine gas applied to the air, or applied otherwise, for the improvement in efficiency of grease removal by the aeration process; dosages required and resulting efficiency.

(12) Amenability of sewage to self-flocculation without the aid of chemicals; is this a matter of freshness, and of strength as related to suspended solids.

(13) Use of diffusion or other baffles in plain sedimentation units for sewage treatment; comparative efficiencies.

(14) Use of particularly deep sludge hoppers in sedimentation tanks as related to the concentration of the solids; i.e., the water content of the withdrawn sludge.

(15) Use and value of sludge concentration tanks, with or without internal aids, such as paddles, for reducing the water content of raw settled sludges prior to discharge into separate digestion tanks.

(16) Use of longitudinal troughs extending forward for various considerable distances from the outlet ends of plain primary sedimentation basins.

(17) Effect and efficiency of continuous versus intermittent removal of sludge by mechanical means from plain primary settling tanks.

(18) Effect of sludge and/or grease through closed pipe lines of considerable length.

It will be observed that matters of sludge digestion, elutriation, dewatering and disposal have not been set up for discussion although there may be some other sewage treatment plants in California which have equipment and conditions similar in some respects to those of the Richmond-Sunset plant.

SEWAGE PUMPING AND DISPOSAL AT TREASURE ISLAND

By **CHARLES H. LEE,** ***Consulting Engineer***

The Golden Gate International Exposition is a full-fledged modern community requiring all the utilities and public conveniences of a city of 100,000 inhabitants. It was built upon a newly created island in San Francisco Bay, and everything both above and below ground had to be provided in advance.

With great crowds of people from all parts of the world continually mingling upon the Exposition grounds, provision for adequate sanitation was of greatest importance. Treasure Island being within the boundaries of the City and County of San Francisco, enforcement of health requirements is a function of the City Health Department. This duty is being efficiently performed by a staff of City Health Inspectors stationed at the Island for the duration of the Fair.

The Exposition Company, on its part, has provided the physical plant and operating staff necessary to maintain saintary conditions. In furtherance of this function, it has undertaken to provide a potable water supply, to remove waste in the form of sewage and garbage, and, if occasion arises, to cooperate in control of pests such as mosquitoes or rats. This paper describes the facilities and arrangements for these purposes, and particularly those for the handling of sewage.

WATER SUPPLY

Domestic water is supplied directly from the San Francisco municipal system via the Bay Bridge pipe line and Yerba Buena Island Reservoir. Regular bacteriological tests are made by the San Francisco Health Department upon samples of water from hydrants and drinking fountains, and no instances of pollution have been reported. One remote possibility of pollution is in case of major fire, when the San Francisco fire boat might pump salt water from the Bay into the high-pressure system. The domestic system is partly fed from the high pressure at three interior points at which are located pressure reducers and gate valves. Operating personnel has instructions to close these valves in the event of major fire. They are also closed daily beeween midnight and 6 A. M. The domestic system is then supplied only from the reservoir main at the head of the high-pressure system above the salt water check valve. Petcocks are provided back of the check valve for drawing test samples in case salt water is used. There has thus far been no occasion to pump salt water.

Scattered instances of bad-tasting water, due to lack of circulation in certain portions of the pipe system, have been corrected by occasional local drainage of pipes into the storm sewer through blowoffs provided for the purpose.

The average quantity of water required for all purposes upon the Exposition grounds during the month of maximum summer attendance was originally estimated at the rate of 22.9 gallons per capita per day. The actual per capita consumption was 23.1 gallons daily during the month of May, with an average total daily attendance of 37,300, and 21.7 gallons

during July, with an attendance of 58,500. The original estimate assumed domestic use alone at 10 gallons per capita. A later more detailed estimate, made in connection with the design of the sewer system, indicated a value of 6.6 gallons for a day of average maximum attendance. Actual quantities for domestic use, as measured on days when other uses were negligible or accounted for, were 6.2 gallons per capita on February 18th with attendance of 143,497, and 6.9 gallons on February 19th with attendance of 113,912. On days of smaller attendance the per capita use approaches 10 gallons.

GARBAGE

Garbage is removed from the Exposition grounds by a licensed garbage collection agency under contract with the Exposition Company. Wet restaurant garbage fit for hogs amounts to 10 tons per day and brings in a revenue of $1.50 per ton. Other garbage, amounting to 30 tons or more a day, originates both from the Exposition and concessionaires. The former contributes principally grass cuttings, garden weeds, paper towels, and street sweepings. From concessionaires is obtained the ordinary dry garbage and, in addition, unsalable wet garbage such as coffee grounds, hot dog stand refuse, with broken glass, etc. Garbage is collected in packages or large cans weighing approximately 60 pounds, and transported by truck to the San Francisco Sanitary Fill. Charges at the rate of $0.26 per package or can are paid for by the Exposition, and concessionaires are billed for their proportion. The rate is 1 cent higher than the regular San Francisco rate, to include bridge toll, etc.

PEST CONTROL

There has been little trouble with pests at Treasure Island. No evidences of mosquitoes were observed prior to August, but, to forestall the possibility, the 500 catch basins were treated with oil occasionally. During the month of August, mosquito larvae were found in sheltered coves of the Lagoon and the infected areas were sprayed with stove oil. Recently the presence of rats has been reported, and steps are being taken to trap them. Carp, which accidentally got into the seven-acre pleasure lagoon, are the only real pest problem. They make the water muddy and have evaded attempts at removal by hiding under overhanging structures or burrowing into the mud. Nearly 1500 one-pound carp have been taken out by various means, the most effective being poisoning by use of powdered derris root at the rate of one pound to 500,000 gallons. This dose is three times greater than that proved effective for perch and was tried only after the normal dosage failed to bring the carp to the surface.

STORM WATER

Ten separate systems of gravity storm sewers having outlets at the sea wall were installed to carry off storm water.

SEWAGE COLLECTION

Treasure Island is a dredger fill rectangular in shape, 5520 feet long, 3400 feet wide, containing 400 acres. It is retained and protected from erosion by a rock sea wall. Finished grade elevation of the top of the sea wall was +14 feet above mean lower low water in San Francisco Bay, and of the general surface of the fill +13 feet. Elevation of mean higher high water is +6.14 feet, and maximum high tide +8.50 feet.

The flat low topography of the Island and the requirement of delivering sewage at a single point for disposal, introduce conditions which are unusual in California, and compelled the collection of sewage by pumping from numerous widely distributed sumps into a single force main for delivery at the disposal point. In connection with the design of the sewage collection system for Treasure Island, much useful information was obtained from the City Engineer of Georgetown, British Guiana, and from the Chief Engineer of the Georgetown Sewerage and Water Commissioners, where an all-pumping system is operated serving a city of 65,000 inhabitants.

Quantity of Sewage— The usual sources of sewage waste are from domestic and industrial water use, infiltration from ground water, and storm water. At Treasure Isand, however, industrial waste is nominal, infiltration is absent because the water table is kept below the sewers by drainage pumping, and storm water is disposed of through a separate system of storm drains. Domestic sewage is therefore the only source and originates principally from toilets, drinking fountains, and culinary uses at restaurants, street booths, and food exhibits.

In estimating the daily quantity of sewage to be handled, the following data based upon experience at Chicago's Century of Progress and other Expositions were used:

From toilets—76 per cent of attendance x 2.8 gallons per capita.

From drinking fountains—100 per cent of attendance x 2.0 gallons per capita.

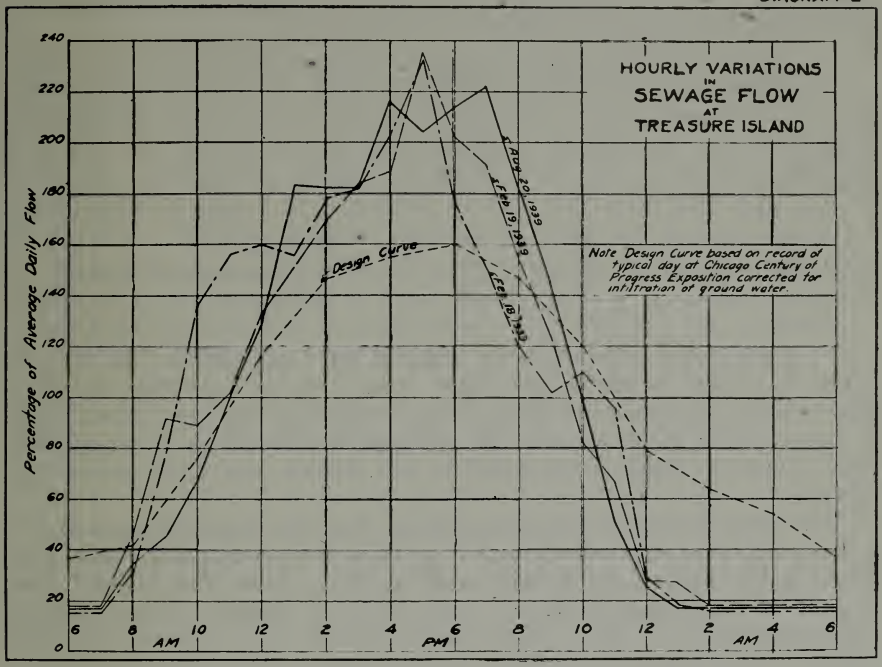
From culinary uses—100 per cent of attendance x 2.0 gallons per capita.

On this basis the daily per capita sewage flow on an average maximum day was computed at 6.6 gallons, and on a maximum day 6.1 gallons. Actual measurements of sewage flow on February 18th (attendance 143,497) gave 6.2 gallons per capita, and on February 19th (attendance 113,912) gave 6.9 gallons. There was no garden watering on these days, and after deducting lagoon make-up water, these quantities were found to correspond closely with measured per capita water supply. Assuming the latter relation holds consistently, the daily charts of total water flow on days with no garden watering or draft for fountain and lagoon make-up indicate that the per capita sewage flow for days of smaller attendance (50,000 to 75,000) varies from 8 to 10 gallons.

For design of the collecting and disposal systems, the hourly variation in sewage flow was assumed in conformity with that shown by measurements of total sewage flow during a typical day at Century of Progress Exposition after deducting for infiltration of ground water (Diagram 2). This indicated a nominal flow from midnight to 8 A. M., commencing to increase by 8:30 P. M., reaching a peak of 160 per cent of the average between 5 and 7 P. M., decreasing rapidly until 10 P. M., and gradually to midnight. Measurements of total flow at Treasure Island on February 18th and 19th and August 20th, 1939, show a similar variation but with a wider range than at Chicago, the peak being 230 per cent of the average (Diagram 2).

Two methods were used to estimate sewage flow at Treasure Island. Fundamental to both methods is the daily Exposition attendance made up of paying visitors and non-paying personnel consisting of employees, exhibitors, etc. This was estimated by the Division of Water Supply and Sanitation,

DIAGRAM 2



using known ratios of paid attendance to local population at other expositions, deducting 12.5 per cent for transportation resistance and adding 35 per cent for non-paying attendance. The figures arrived at by this method were as follows:

Average daily paid attendance (288 days)	61,400
Average daily total attendance (288 days)	83,000
Average daily maximum total attendance (30 days)	95,000
Maximum day total attendance	332,000

Actual attendance figures for July 1939 are:

Average daily paid attendance	49,000
Average daily total attendance	60,166

For design of gravity collecting lines, force main and pumping installations, the flow contributed by individual toilet and other fixtures was estimated. The basis of this estimate was the "toilet unit" designed to serve people congregating within a convenient distance and consisting of 9 water-closet, 2 urinal, and 4 lavatory fixtures. Auxiliary to each toilet unit it was assumed there would be 3 drinking fountains, 6 grill seats, and 6 restaurant seats. It was considered that gravity laterals and pumps should have sufficient capacity to carry the flow during the maximum hour of the maximum

attendance day. The flow from a toilet unit and auxiliaries during such period was estimated as follows:

Type of Fixture	Fixtures per unit	Gallons per flush	Flushes per hour	Gallons per hour	Average Hourly Flow gals. per min.
Water closets	9	3.0	20	540	9.0
Urinals	2	1.0	6	12	0.2
Lavatories	4	0.5	29	58	0.97
Sub-total				610	10.17
Drinking fountains	3	@	0.33 g.p.m.		1.00
Grill seats	6	@	0.11 g.p.m.		0.66
Restaurant seats	6	@	0.25 g.p.m.		1.50
Total					13.33

For areas where planned toilet facilities were unknown at the time of preparing designs for the sewer system, it was assumed that there would be 2.68 toilet units per acre of building area as modified from the known value of 3.1 at Century of Progress. The aggregate maximum rate of sewage flow from Treasure Island as computed by this method was 3335 gallons per minute.

The other method of estimating sewage flow was from daily attendance and per capita water consumption. It assumed that sewage flow would consist of 100 per cent of the domestic water use plus exhibitor's use and a fixed amount for sewer flushing, waste, leakage, etc. As estimated by this method, the total sewage flow for the maximum hour of the maximum day was 2800 gallons per minute.

For design of disposal works, the following adjusted values were used, based upon the results of both methods:

Condition	FLOW RATE Gallons per day	Gallons per min.	Second-feet
Maximum hour of maximum day	4,300,000	3000	6.69
Max. hour for average max. day	2,300,000	1600	3.35
Average for average day	1,440,000	1000	2.23
Minimum	540,000	375	0.84

Relative sewage flow at various times in terms of that during the maximum hour of the maximum day was estimated as follows:

Maximum hour of maximum day.....100%
Average for maximum day 63%
Maximum hour of average maximum day..... 53%
Average for average maximum day..... 33%
Minimum hour of average maximum day..... 12%

These percentages were used in design of both collecting and disposal works.

Gravity Collecting Lines— Sewage from exposition toilets, restaurants, and other sources is discharged into short gravity lines and carried thence to the sumps. These lines are of various lengths up to a maximum of 900 feet. They have minimum slopes of .006 for 6-inch, .004 for 8-inch, and .0029 for 10-inch pipe and discharge into sumps at elevation +6.0 feet. Allowing 2 feet of cover the total drop available for each line was between 4 and 4.5 feet. This permitted the laying of some of the lines with slope exceeding the minimum.

Pipe sizes were selected to carry a maximum rate of flow at from half full to full and with as high as possible a minimum velocity, the latter being assumed to occur during the hour of least flow on a day of average maximum attendance (12% of maximum). Pipe sizes range from minimum of 6 inches to maximum of 10 inches. Range of velocity is from 2.0 feet per second maximum to 1.25 feet per second minimum. For small flows in 6-inch size where laid on minimum slope the velocity is less than minimum. All pipe was specified as A.S.T.M. standard vitrified clay sewer pipe with asphalt filled joints. Wooden manholes occur at all angle and junction points.

Pump Sumps—There are 14 pump sumps on the Island. These are located at points convenient for short gravity delivery from large toilets or building groups, and also in conformity with a simple force main layout. Sumps are constructed of reinforced concrete with inside dimensions 5′ x 6′6″ x 10′, and bottom floor level at elevation +2.25 feet. They are divided horizontally into two compartments by a steel floor plate, a 6-foot sump chamber below and 4-foot pump chamber above. The floor plate acts as support for the pumps, motors, float switches and magnetic starters. Four-inch vents are provided from sump chamber to grating box at the street level.

Sewage Pumps—Pumps are of centrifugal type, non-clogging, screenless, sewage ejectors with two-bladed impellers and clearance sufficient to pass 2½-inch spheres. They are electric motor driven and operated by automatic float switches. Suction inlet is 4 inches above bottom of sump. Pump installations are in duplicate and at sumps in congested areas in triplicate, with discharge into a single header leading to the force main. Check valves are placed on the discharge of each pump and a gate valve on the header to cut it off from the force main when necessary. The first pump in each sump group operates within a range of 3 feet (Elev. +3.5 to 6.5 ft.), thus providing a storage volume of 750 gallons. Floats for the second and third pumps are set successively 3 or 4 inches higher than for the first pump. The capacity of the first pump is sufficient to handle the average flow on the maximum day. All pumps at any sump will handle peak flows up to 1½ times the maximum hourly flow on the maximum day. There are 28 pumps installed in sumps discharging into the force main with capacities ranging from 50 to 300 g.p.m. and with aggregate capacity of 4550 g.p.m. Motor capacities range generally from 3 to 10 H.P. with a total of 150 H.P. In addition to the above, small sewage ejectors of 1 to 3 H.P. are used in several buildings to boost sewage into the gravity line.

Pumping units are all interchangeable, and a spare is available at all times so that in case of trouble units may be exchanged or replaced without delay, an extra manhole having been provided in the floor plates of all sumps.

Force Main—All pump headers discharge into a single force main system with riser at outlet discharging into the sewage treatment plant at elevation +20.8 feet. The maximum pumping head for each pump is determined from the hydraulic gradient with all pumps operating at maximum capacity and ranges from 30 to 53 feet. The minimum pumping head is that with the single pump under consideration in operation. Pumps were selected to give the most efficient service within this range. Force main is light steel pipe (No. 14 gauge), asphalt dipped, with sizes ranging from 8 to 16 inches. Headers and force main have a downward slope to base of

riser outlet and can be drained at this point through a blowoff line extending through the sea wall into the Bay.

SEWAGE DISPOSAL

Requirements— The requirements set up for satisfactory sewage disposal from Treasure Island were that it should not produce conditions objectionable to the senses or dangerous to health in any of the following ways:

1. Objectionable pollution of Bay Waters adjacent to Treasure Island or to adjacent shores because of the presence of floating solids, grease, or discoloration due to dissolved organic matter.
2. Pollution or discoloration of the sea wall around Treasure Island or the adjacent shores by depositing of sewage solids or organic growths.
3. Pollution of the air by objectionable odors.
4. Bacterial contamination of Bay waters adjacent to the southeast sea wall or in the Navy Lagoon.
5. Creation of exposed or shoaling sludge beds.

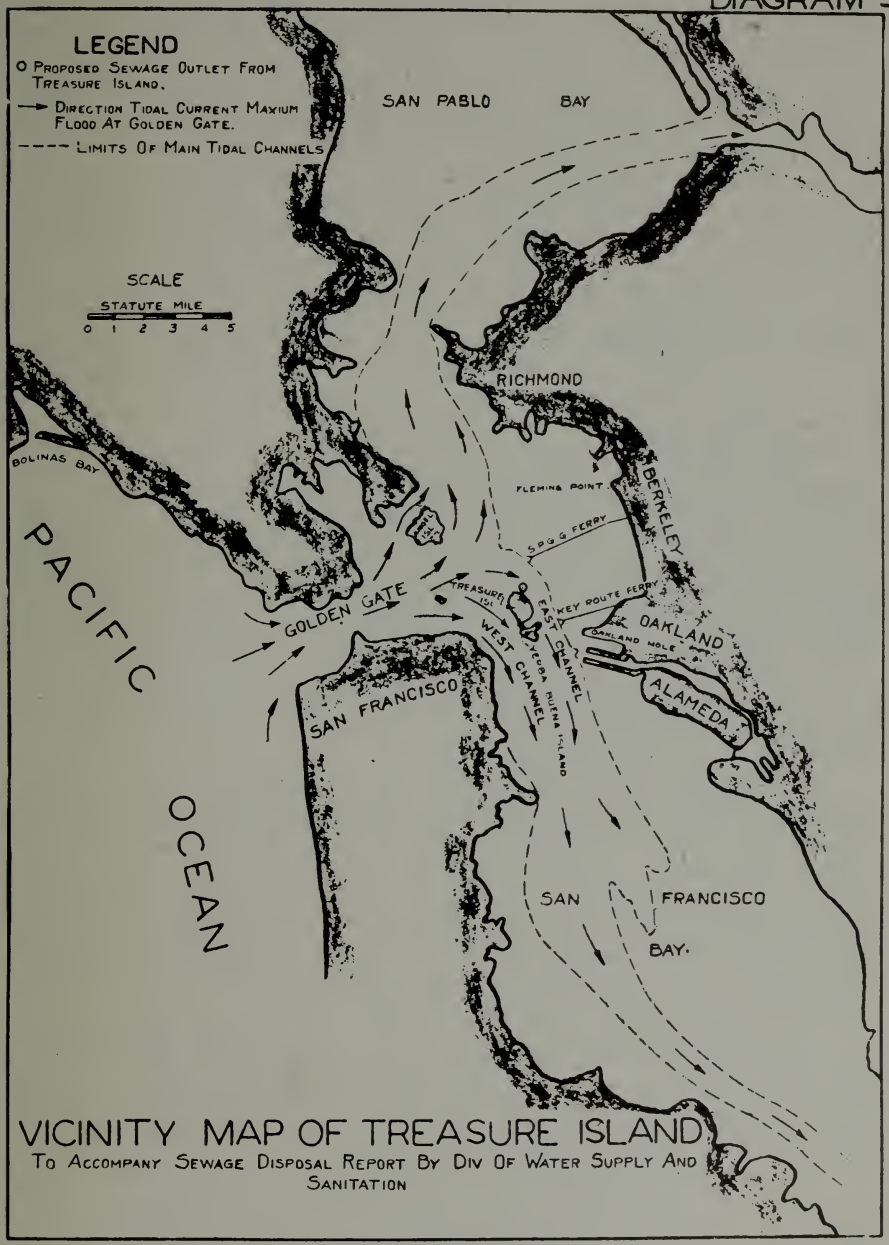
Treasure Island is ideally located for meeting the above requirements, by dilution of the sewage in the waters of San Francisco Bay (Diagram 3). Temperature conditions are uniformly cool and the prevailing west winds are regular, particularly during the warmer months. The Island is surrounded by a wide expanse of deep salt water which is kept in continuous motion by active tidal currents. These waters are freshened twice daily by the incoming flood tide through the Golden Gate. They have a high saturation point for dissolved oxygen, and an available oxygen content close to the saturation point.

The average rate of tidal flow past the Island, as represented by the portion of the tidal prism entering South San Francisco Bay, is 1,300,000 cubic feet per second, of which more than 100,000 cubic feet per second flow through the East Channel. It is stated by sewage authorities that for open tidal waters, if the tidal stream exceeds 500 to 1000 gallons per day for the sewage of each person, the water will remain clear and inoffensive. Assuming a maximum day's attendance at the Exposition of 332,000 equivalent to an established community of 116,000 inhabitants, the required daily flow of tidal water per person would be 58,000,000 to 116,000,000 gallons per day. The actual flow is between 560 and 1100 times greater than the maximum requirement.

Sewage Disposal by Dilution— The disposal of sewage by dilution in sea water is very effective under certain conditions and has been adopted by many coast cities throughout the world. An important requirement for success is that the effluent be discharged through an outfall with submerged outlet. An active tidal current at the outlet is also desirable.

Sewage, being lighter than sea water, rises from a submerged outlet in a column of increasing diameter much as does smoke from a chimney. Upon reaching the surface the column spreads laterally in a relatively thin layer, forming a field which is circular in quiet water and elongated in moving water. The limits of the field are reached when the specific gravity of the sewage has been increased by dilution with salt water to nearly that of sea water. At this point stratification breaks down and the field fades out. Experience has shown that the degree of dilution attained at this stage is usually

DIAGRAM 3



VICINITY MAP OF TREASURE ISLAND

TO ACCOMPANY SEWAGE DISPOSAL REPORT BY DIV OF WATER SUPPLY AND SANITATION

sufficient to overcome all the objectionable features of a sewage effluent, including excessive bacterial pollution.

The dilution which takes place in the expanding column is very rapid and any means for increasing the length of the column adds to the efficiency of the

process. Increased length can be secured by increasing the depth of submergence, discharging on an incline or horizontally instead of vertically, and by discharging in tidal currents of greater velocity.

For years there have been various empirical factors in use for predicting the area of sewage fields from submerged outlets, such as "acres per second foot" or "acres per 1000 population." These factors are arbitrary and do not take into consideration important elements such as depth of submergence, type of outlet, tidal drift, etc. Within the past ten years two comprehensive experimental investigations have been made, the results of which furnish a rational basis for pre-determining the limits of a sewage field. One of these was made by the City Engineer's Department, City of Capetown, South Africa, in Table Bay (1); the other by the Engineering Department, Los Angeles County Sanitation District in Los Angeles Harbor (2). Conclusions reached in these independent investigations do not differ in essentials. The Rawn and Palmer work has been the basis of studies made by the Exposition's Division of Water Supply and Sanitation.

Tidal Currents—Intimately connected with the problem of sewage disposal at Treasure Island are the tidal phenomena of San Francisco Bay and particularly those in the vicinity of the Island as modified by the completed fill. Intensive investigations of current direction and velocity in these waters were made prior to development of plans for sewage disposal. The purpose was to determine, (1) the best location in the tidal streams adjacent to the Island for discharge of sewage without danger of being carried onto the sea wall or nearby shore, and (2) the velocities of flow which would have to be considered at various depths in design. These studies were based upon three types of float surveys, using submerged floats, milk-bottle tops, and Urinine-N dye. Vertical velocity curves were also developed at critical locations by use of a current meter.

Submerged floats were constructed of wood following standard design. This type of float is influenced but little by wind, and indicated direction and velocity of current in the top 3-foot layer. A total of 52 releases were made in both West and East Channels and on both flood and ebb tides. Paths followed by floats were determined at intervals of a few minutes by sextant from a boat and time of observation noted. It was concluded from these tests that the most satisfactory point for discharge of sewage from Treasure Island was in the East Channel 1000 feet northeast of the northeast corner of the sea wall at an average depth of 39 feet.

To check this location, further investigation was made by releasing paraffined milk-bottle tops. Of 1000 tops released on flood tide, none were found deposited at the sea wall or upon the shores of Yerba Buena Island. Several days later, during inspection of the East Bay shore from Richmond to Alameda, two were found at Fleming Point.

Tests made with Urinine-N dye gave the most convincing results. Eight one-pound charges dissolved in two gallons of water were released from a boat at the site of the proposed sewer outlet, two on the ebb and six on the flood tide. The path and spread of the dye was easily observable from the center of the cantilever span of the Bay Bridge. It was concluded from this test that:

1. The direction of current during ebb is northwest and would carry sewage effluent away from the Exposition Fill.

2. The direction of current at the commencement of flood is south-southeast, with a slight tendency toward the sea wall but following the point of advance of the overrun.

3. The direction of current during flood is southeast to Pier E3 of the San Francisco-Oakland Bay Bridge, and thence south into the open Bay.

4. Dilution of the dye field at the Bridge was at least 1 to 66,000 based upon an initial volume of dye of two gallons and final field dimensions of 150-foot diameter and an assumed one-foot depth. Critical dilution at which sewage effluent ceases to be recognizable is between 1 to 200 and 1 to 225 (3).

Current velocities for different levels at the proposed point of discharge indicated a maximum surface velocity of 4.25 feet per second, and bottom velocity of 2.0 feet per second. These were made during ebb flow with a tidal range of 6.1 feet. The maximum surface velocity during a four-foot range did not exceed 3.77 feet per second.

Design of Outlet— Sewage fields are identified by "sleek" surface caused by floating oil, by discoloration of the water produced by floating and dissolved solids, and by bacterial pollution. There may also be odor. The "sleek" surace is practically coextensive with the discolored and excessively polluted areas, and marks the practical limits of the sewage field. The experimentally developed formulae enable the approximate area and dimensions of such a field to be pre-determined, if basic data are available, such as diameter and position and number of outlets, depth of submergence, rate of sewage discharge, and velocity of tidal current. Such data were assembled for design of the proposed Exposition outlet as follows:

1. Three possible outlet sizes were considered, three 10-inch, one 12-inch, and one 16-inch, each with both horizontal and vertical position.

2. Tidal current velocity was considered both for slack water (0.0. ft. per sec.) and for maximum flood or ebb (4 ft. per sec.).

3. Sewage discharge was considered at maximum rate (3000 g.p.m.), average (1000 g.p.m.), and minimum (375 g.p.m.).

4. Depth was assumed as 39 feet, being the average depth at the end of the proposed 1000-foot outfall.

5. Final dilutions were assumed at 1 to 50, 1 to 100, and 1 to 225. The latter is of greatest interest as the experimental formulae corroborated by tests at several sewer outlets in Southern California indicate that it is well beyond the limits of the sleek field, discoloration of water, and excessive bacterial pollution (4).

The results of calculations, using these data in the formulae developed by Rawn and Palmer at Los Angeles Harbor, indicated that horizontal outlets would be much more effective in obtaining dilution than vertical outlets. They also showed that the aggregate area of sewage fields from three smaller jets was slightly less than from a single larger jet. After consideration of costs, it was concluded that the single outlet was preferable.

The 12-inch horizontal outlet was selected as best adapted for conditions at the proposed Exposition sewage outlet. The area of the field over this outlet at maximum flood or ebb and for maximum rate of sewage discharge was estimated to be 2.7 acres, the longer axis being 900 feet with the current and the maximum spread 250 feet. The thickness would be nearly 5 feet. This field would pivot around the outlet, extending southeast in flood and

northwest in ebb. At slack the field would center over the outlet with area of possibly 3.0 acres. The latter condtions would not continue long, however, as the turn of the tidal current at this location occurs within a period of a few minutes. For ordinary rates of sewage discharge the area would not exceed 0.5 acres at any stage of the tidal current, with longest axis of 400 feet lying in the thread of the current.

From these and other studies it was concluded, that, for an outfall extending 1000 feet northeast of the Exposition Fill, with 12-inch horizontal outlet, dilution of comminuted Exposition sewage would be obtained within a short distance of the outlet, ample to overcome all objectionable features such as sleek surface, discoloration of water, odor, and excessive bacterial pollution. The sewage field would be at such distance from the north and east sea walls and the freight ferry slip that it would not be noticeable therefrom. Beyond the sewage field the sewage effluent would be so dilute that it will differ little if any from Bay water, and at a distance of 6000 to 7000 feet, opposite the entrance to the Navy Lagoon, would be too dilute for identification.

Treatment Plant— The first step in disposal of Treasure Island sewage is reduction of floating solids to unidentifiable size. Although this function is performed to large degree by the pumps, the tougher objects such as paper toilet seats, cloth, fruit, etc., pass through without change. In order to insure complete reduction of solids before discharge of sewage into the Bay, comminutor equipment was installed between the end of the force main and the head of the outfall line.

The plant is of simple design, consisting of three open gravity flow channels, two outer ones leading to the comminutors, and the third a bypass, all built upon an enclosed platform 10 feet above the ground surface. Discharge from the comminutors or bypass is into a weir box and thence to the head of the outfall line. Elevation of top of side boards in comminutor channels is +22.5 feet, and in weir box +22.0 feet. The latter represents the maximum pressure head level on the outfall sewer line. Piping is arranged so that discharge from the force main may enter the outfall line through the plant or through a by-pass line around the plant. A blow-off line, leading from the by-pass to the Bay, permits draining the force main system.

There are two comminutors, each being a self-contained unit provided with ¼-inch slotted openings for screening and cutting up sewage solids. Each unit is provided with teeth for cutting up the sewage solids without removing them from the flowing sewage and fine enough to permit solids to pass through the slots. Comminutors are 15-inch size and rated capable of passing a maximum flow of 2.5 m.g.d. of comminuted sewage with head loss not exceeding 6 inches. They are equipped with 1½-H.P. motors and timing device to permit operation on any desired schedule. In addition, a float switch in the channel above the comminutor unit is set to start both units when the sewage level becomes high in order to clear the slots of banked up solids and permit maximum flow.

Outfall Sewer—The outfall sewer line consists of 1000 feet of 18-inch diameter No. 16 gauge galvanized corrugated iron pipe. The galvanizing is asbestos bonded and the pipe hot asphalt dipped. Joints are made with five

corrugation 12-inch watertight band couplers fastened to adjoining pipes by four ½-inch steel hoops around the coupling band. This type of pipe was chosen for durability and as most economical because its lightness and flexibility permitted launching by floating in position and sinking. Bids on an alternative of welded steel pipe were $11,000 as compared with $8,000 for corrugated culvert. It is laid on the existing bottom of the Bay approximately on a line extending at right angles to the sea wall opposite the treatment plant. It is anchored by means of pairs of concrete blocks weighing 75 pounds, each pair being joined with a short length of flexible ½-inch steel wire rope and laid over the top of the pipe at 7½ to 5-foot intervals. The pipe is terminated in a gooseneck and 12-inch nozzle discharging horizontally 30 inches above the bottom, where average depth of water is 39 feet.

The maximum capacity of the line as designed with water level in the weir box at elevation +22.0 feet and in the Bay at mean higher high water (+6.5 feet) is between 2640 and 3400 g.p.m., depending upon the true value of the friction coefficient in the Kutter formula between variously reported test limits of 0.21 and 0.25.

Launching the outfall sewer involved several unusual features which were developed by the contractor. The pipe was assembled in 40-foot lengths along the northeast sea wall of the Exposition fill, being placed on skids and held in position by braces at an elevation two feet above higher high water and with inner end at the point where the line was to pass through the sea wall. In this position, field joints were made and concrete anchors placed over the pipe. Temporary 100-pound anchors to aid in holding the pipe against the current were also fastened with 200 feet of rope to the pipe at 100-foot intervals prior to launching. As the pipe was floated into position these anchors were dropped at points marked by spar buoys located 200 feet upstream from the final pipe location. The lines on the anchors could be adjusted to bring the pipe into proper position.

It was proposed to launch the pipe as a single piece 1,000 feet long by sliding it down the skidways into the water and towing the north end into position with a tug. The shore end was to be held with the open end above water by means of a cable operated from a power derrick. The outlet end was supported by two oil casks lashed to the frame beneath the nozzle and the latter sealed with a temporary wooden plug. When in position the pipe was to be submerged by pulling the plug, cutting loose the casks and allowing water to enter from the outer end. In order to retard the rate of sinking, and prevent pulling apart of joints, waxed paper tubes, six inches in diameter with ends sealed, were strapped to the pipe with spiral wrap of light weight roofing paper. A sufficient number of tubes was used to reduce the effective weight of the submerged pipe with anchors from 31 pounds per lineal foot to two pounds. It was calculated that the 18-inch pipe, supported by the tubes, would fall to the bottom in 15 seconds, and that this would prevent development of abnormal longitudinal stresses in the joints. A continuous length of 16-gauge wire was placed on top of the tubes under the wrap and fastened to the last tube at the outlet end to use in releasing tubes after the pipe reached the bottom.

The water is often very rough at the site of launching, with wind, waves, and strong current. After waiting several days, the launching was accom-

plished at low tide the morning of June 16th, 1938, with ideal weather conditions. Due to exceptionally low tide, the pipe lodged on the sand beach and rocks at the base of the sea wall and a delay of about 40 minutes occurred before the pipe with concrete anchors could be floated. The outer end was then swung out into the stream in quiet water at slack tide without difficulty, the temporary anchors being carried in rowboats and dropped at their respective buoys as the pipe passed over them. When the pipe had almost reached position, a rapidly advancing rip tide in wedge shape struck the center of the line, bowing it locally. Effort was made to straighten the line by pushing

LAUNCHING THE TREASURE ISLAND OUTFALL SEWER LINE

against it with two launches. This proved fruitless, and with the spread of the rapidly moving tidal water against the whole length of the pipe, other bows developed and the temporary anchors began to drag. While in this condition, the plug was pulled and float lashings cut, and the line sank progressively inshore. Many of the tubes shot up out of the water immediately after submergence and prior to being released by pulling of the 16-gauge wire. The total time required for the entire pipe to reach the bottom was reported by two different observers as 6 and 13 minutes.

The second anchor from shore apparently did not drag, thus causing the line to bow so badly that it parted at a joint about 300 feet from the sea wall, the two ends lying on the bottom several feet apart and with an angle of 35°+ between them. The gap was closed by a diver employed by the contractor, using a six-foot length of 18-inch corrugated pipe. Collars three feet long composed of two half-sections of 21-inch corrugated pipe were placed over each joint and held in place with steel bands. Tests made after repair indicated minor leakage. Subsequently, after the opening of the Exposition and with greatly increased sewage flow, it was found that most of the flow was issuing at the location of the leak. Inspection by diver showed that the two halves of the collar had failed to meet by four inches at the

bottom of one of the joints, and that the two ends of the pipe were seven inches apart, with strong flow through the opening. An excavation of considerable size was found in the bay bottom beneath the hole. The latter was probably caused by the blowing out of mud or sand which had banked up against the opening and closed it during the pre-Exposition period.

Repairs were made by a diver removing the collar and substituting a sheet of lead 26 x 84 inches in size and ⅛ inch thick, bending it around the pipe to conform to the shape of the adjacent ends and fastening it with steel bands. This effectively closed the joint and reduced leakage to a nominal and intermittent flow.

OPERATION EXPERIENCE

Sumps have been the source of several minor troubles and have required daily inspection and servicing. The first difficulty was failure of the float switch to trip on the rise. This was remedied by adding a second float ball on each float rod. Several float switches failed to operate due to swelling of fiber packing. This was remedied by filing down the packing which had swelled with moisture during the winter months. Accumulation of toilet seat paper around the float rod have frequently prevented the rise of the floats. This, and the tendency to formation of a thick crust in the sump chamber, have been overcome by piping domestic water to each sump so that hose connection can be easily made and balled paper or crust broken up with a jet of water.

Outages due to the above causes, supplemented by power outages, resulted in flooding several of the motors during the pre-Exposition period. To prevent this, overflows have been constructed in all sewer sumps and connected to the nearest storm sewer manhole. This has effectually stopped the flooding of motors, and, as overflow occurs but rarely, odor from the storm sewer can be prevented by flushing.

For nearly eight months after completion the sewage system was used for disposal of sewage originating from construction forces of approximately two thousand men. The quantity of sewage was so small that there was danger of clogging the force main with decomposing solids if flow were discharged through the treatment plant. Sewage was therefore bypassed through the blowoff and gravity flow depended upon for clearing the pipes. Local accumulations of solids were flushed out prior to opening the Exposition by using fire hoses and a total flow of 1400 g.p.m. for a period of about 45 minutes. The treatment plant was then put into service and has operated without any stoppages in the force main.

At the treatment plant trouble has been experienced by soft sticky floating material adhering to the sides of the channels and the comminutors, thus creating odor. This material is easily removed by hosing, if done before it hardens, and a weekly schedule has been in effect since late spring. Clogging of comminutor slots with restaurant grease has also occurred, materially increasing the head loss and cutting down the flow capacity. This deposit is hard and requires insertion of a thin flat metal tool for removal. This is done once or twice a week. The comminutor schedule in effect during the summer has in general consisted of running each unit ½ hour in every two hours, staggering the units.

The most serious difficulty at the treatment plant has been occasioned by

a stoppage in the outfall line reducing the capacity to 1885 g.p.m. This occurred prior to the final repair of the leak in the outfall on April 8th, 1939. The stoppage was probably caused by deposition of solids beyond the leak, where the velocity was very small due to escape of most of the flow at the leak. The failure of deposits to erode with the higher velocities, occurring after the repair was made, may be due either to the cohesiveness of the deposits or inclusion of cloth rags which frequently appeared in the sewage during the opening days of the Exposition.

Sewage flow has been very irregular, varying from 0 to more than 2500 g.p.m., depending upon the number of pumps in operation at any one time. It has never exceeded 3000 g.p.m., which is the designed capacity of the outfall and two-thirds of total pump capacity. Peaks in excess of 1885 g.p.m. seldom last more than one minute, and the volume of sewage represented is very small (less than 0.5%). They occur only during the peak flow period of the day and sometimes several days will pass without excess flow. In order to prevent overflow of channels and flooding of the plant, two overflow pipes with tapered inlets have been inserted in the channel walls, one above and one below the comminutors. These pipes discharge peak flows into the Bay through the blowoff line. Discharge from this source has created no nuisance of any kind and provides a temporary means of preventing overflow at the plant pending the location and removal of the obstruction in the outfall line.

Conditions at the sewage field have been even better than predicted, the field being invisible from a distance and difficult to locate even from a boat in the vicinity.

COST

The total cost of the sewage system, including force mains, pumps, gravity collection system, and disposal works, serving 320 acres and for an equivalent city population of 116,000 people, was as follows:

Force main system	$48,000
Gravity collection system	19,000
Treatment plant	6,000
Outfall	8,000
Additions	5,000
	$86,000

The sewage system at Treasure Island was designed and constructed by the Department of Works, of which W. P. Day is Director. The Division of Water Supply and Sanitation, of which the author is Chief and R. F. Lauenstein is Assistant Chief, made all preliminary studies, prepared plans and specifications, and have advised during operations.

(1) Extension of Green Point Sea Outfall, Capetown, by W. J. Houghton and H. C. Mason, Proc. Inst. of Municipal and County Engineers, African Dist., April, 1931.

(2) Pre-determining the extent of a sewage field in sea-water by A. M. Rawn and H. K. Palmer, Trans. Soc. C. E., Vol. 94, 1930, p. 1036.

(3) Trans. Am. Soc. C. E., Vol. 94, 1930, pp. 1051-58.

(4) Trans. Am. Soc. C. E., Vol. 94, 1930, pp. 1051-1057.

POLLUTION OF NAVIGABLE WATERS OR INTERSTATE STREAMS FROM THE STANDPOINT OF THE FEDERAL GOVERNMENT OR ARMY ENGINEERS

By EDWIN C. KELTON*
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Pollution of waterways, including all streams, lakes, rivers, their tributaries, and the oceans, is a direct or an indirect result of population. As a country develops, its population and business growth is closely paralleled by the growth of those factors which tend to increase pollution of inland and coastal waters. Industrial waste matter, refuse, and sewage; mining waste and drainage water; disposal of garbage and many other such waste matter, entailed by a high-standard development of both population and resources, cause corresponding increase in pollution problems. The increase of pollution of the waters has been gradual and largely unnoticed for many years. As is usually the case, until the needs of the population become urgent and a public demand arises for its abatement, little is done. Public demand generally results in the enactment of needed pollution laws, or their revision, and insistence in their enforcement. Of the various laws that have been enacted by cities, counties, states, and the Federal Government, this paper considers only existing and proposed Federal laws concerning the pollution of navigable waters, the enforcement of which are or may in the future be within the jurisdiction of the Corps of Engineers, U. S. Army, of which I am a member.

Because of the limitations imposed by States' rights, the existing Federal pollution laws pertain primarily to *navigable waters*. During the recent session of Congress, consideration was given to the enactment of suitable Federal laws that would prohibit pollution of interstate streams and lakes; consideration being given to health, recreation and wild life. Similar Federal legislation had previously been proposed on numerous occasions prior to 1938, but interests whose operations would be affected thereby have successfully prevented enactment of such Federal law.

Congress, in 1938, passed a bill commonly referred to as an "Anti-pollution Bill." This measure was not an enactment prohibiting pollution, but rather an act to provide for extensive and costly study of pollution problems and for grants and loans to local agencies for the construction and installation of improvements designed to prevent pollution. The President vetoed this bill because he disapproved the manner of granting Federal money to local agencies for pollution abatement projects. He did, however, approve the principle of pollution abatement and requested that Congress further consider this subject.

During the last session of Congress two pollution bills were introduced. One was similar in form to the bill passed during the previous session that the President had vetoed, and which in fact is not an anti-pollution bill. The organization it proposed would be a part of the Public Health Service. The other bill *was* a pollution prohibition bill and provided "teeth" to insure

*Col. Kelton's Paper read by Capt. N. A. Mathias.

enforcement. Enforcement of this measure would be a duty of the Corps of Engineers.

The second bill just mentioned, as first submitted, was so rigid in its requirements that it created great opposition. In order to make it more reasonable and workable, the bill was modified, and in that form it was favorably received. The sponsor (the Honorable Karl E. Mundt of South Dakota) of the bill states that it is fair to all interests. It will not become effective until two years after passage. He points out that pollution has been the subject of study for many years and that there is little excuse for pollution from a scientific point of view. However, the bill is lenient, since there is a provision whereby the Chief of Engineers can, when it is impossible or impractical to comply with established standards of purity, extend the "period of grace" for five years before violators are recommended for prosecution. The bill further protects local interests by providing that in case an industry can show at a public hearing that there is no "possible or practicable" method of eliminating the pollution, the Chief of Engineers is then empowered to grant "such further extension of time as may be reasonably necessary."

The proponent of the bill also states that the public is entitled to have and use the public waters in an unpolluted condition, that public streams are not public sewers, and that the responsibility for pollution rests with the agencies causing pollution. He states that it is not a proper government function to provide special loans and grants of money to agencies who have neglected to install improvements to prevent pollution. Furthermore, he states that it would be unfair to the agencies that have invested their money in improvements to prevent pollution, to tax them in order to pay for like improvements pertaining to other, or possible rival, agencies that have neglected to make such improvements. The *alternate bill* is said to be a "blind," inasmuch as it is not a bill to prevent pollution and would cost the public large sums of money, and also will merely "put off the day of reckoning" when pollution will be rigidly prohibited.

Neither of these bills has come up for final consideration by Congress, but they will probably be considered in January 1940.

Pollution of navigable waters of the United States has, under existing laws, been unlawful since the passage of the act of March 3, 1899. Later, special Federal laws were enacted concerning garbage and refuse pollution in New York Harbor. Section 13 of the act of 1899 makes it unlawful to place in, or to permit to be placed in, the navigable waters of the United States any refuse matter of any description, except that flowing from streets and sewers and passing therefrom in liquid state, whereby navigation shall, or may be impeded or obstructed. Further, the limitations extend to the placing or deposit of any refuse on the bank of any navigable water or tributary thereto from whence it can float or be washed into the navigable waters by tides, floods, or storms.

In 1924 Congress passed what is known as "The Oil Pollution Act." This act makes it unlawful, except in emergency or accident, for any person to discharge, or permit to be discharged, oil by any methods, means, or manner into or upon the coastal navigable waters of the United States *from any vessel* using oil as a fuel for generation of propulsion power, or any vessel carrying oil thereon in excess of that necessary for its lubrication require-

ments. It is to be noticed in this connection that the law concerns only oil pollution *from vessels.*

I might define *navigable waters* of the United States, since the laws under discussion are applicable only to such waters.

The Federal Court decision states that: "* * * Coastal waters, rivers and lakes are navigable in law which are navigable in fact, and they are navigable in fact when they are used or can be used in their ordinary condition as highways for commerce upon which trade and travel are, or may be conducted in the customary modes of trade and travel on waters, and when they are connected with, or extend to waters of another state or foreign country. * * *"

In connection with pollution of coastal waters, the question arises as to the extent of Federal jurisdiction. It is the present practice of the War Department to include within its jurisdiction the coastal waters of the United States to such distance seaward as may be necessary to give full effect to the laws for the protection and preservation of the navigable waters of the United States. This distance is not controlled by any special limitations of three or twelve miles which may have been set up for other purposes. This practice is an assertion of the right of Congress to prohibit the doing of anything which tends to destroy the navigable capacity of any of the waters of the United States. This extended jurisdiction is applicable only to American vessels. The jurisdiction of the United States over foreign vessels, in cases of pollution occurring seaward of the three-mile limit, has not as yet been settled by treaty, as required by international law.

It might seem that the navigable waters, particularly the ocean, are so extensive that pollution would be inconsequential. Unfortunately, this is not the case. Oil and refuse discharged at sea are carried by winds and surface currents for many miles and may eventually float into harbors or wash ashore on the beaches. Experience indicates that in order to prevent pollution of the beaches, oil must be discharged not less than fifty miles offshore, and garbage should be dumped not less than eighteen miles offshore.

Oil and refuse discharged into harbors have little chance to be carried out to sea, and if not cleaned up promptly, they spread and wash onto the harbor shores, cling to boats and piling, or, in the case of refuse, sink to the harbor bottom.

In southern California particularly, where the beaches are used for recreation by a very large number of people throughout the year, the presence of refuse, garbage, oil, and sewage washed onto the shore, presents a very serious problem, since such are highly objectionable. Oil has been known to so pollute a beach that for days at a time bathers have found it impracticable to use it. No one likes to picnic on a beach or swim where there is oil or garbage such as grapefruit and cantaloupe rinds, empty crates, or old onions, and other refuse, or near a sewer outfall. Oil is most objectionable to bathers, as it sticks to skin and bathing suits and is usually very difficult to remove. The condition of sewage discharged into the water may be somewhat improved by screening, but it has been reported that screening removes only 5% of the solids, leaving 95% to be deposited on the ocean floor, or washed ashore in a more or less objectionable form. Beaches that are frequently or regularly polluted, particularly those near sewer outfalls, are in general shunned by the public.

Within harbor areas, pollution creates an unsanitary and unsightly condition, and sometimes a serious fire hazard. Floating oil discolors paint on ships' hulls and necessitates their frequent cleaning or repainting. Gases released by decaying refuse have a deleterious effect on paint and hulls of vessels and other metal objects, and is offensive to the public.

Floating oil at times so fouls the plumage of sea birds as to prevent their flying, and thereby causes their death. It also has an adverse effect on fish life, apparently causing an oxygen deficiency, which in turn causes migration from areas frequently polluted. Thus, there is ample reason for the enactment and strict enforcement of pollution laws.

The Corps of Engineers is assisted in the enforcement of the Federal pollution laws by the United States Collectors of Customs and other revenue officers, such as the United States Coast Guard. Prosecution is handled by the United States District Attorneys. In the Los Angeles District, the Coast Guard cooperates fully, and patrols are alert to detect and apprehend violators of the pollution laws. The Coast Guard reports all cases to the Engineer Office, and the cases to be prosecuted are in turn forwarded to the United States District Attorney for appropriate action.

The state laws concerning pollution are more inclusive than the Federal laws. The Enforcement Division of the State Fish and Game Commission is very active in detecting and arresting violators. That agency cooperates fully with the Corps of Engineers and the United States Coast Guard. These agencies notify each other when cases occur, and members of the two agencies serve as witnesses for either or both state and Federal cases, where at least two witnesses are required.

Obviously, there are two types of pollution—deliberate and accidental. The dumping of garbage and other refuse, the disposal of sewage, and the discharge of oily bilge or ballast water onto the navigable waters are generally deliberate. The spilling of oil while loading or unloading vessels and the breakage of oil pipe lines so that oil is carried onto the navigable waters, etc., are usually accidental. The deliberate type of pollution can be readily avoided. The accidental type is more difficult to prevent, but the use of adequate equipment, its careful inspection, and the institution of proper procedure and training can greatly reduce the number of accidents.

Although designated by law as the "enforcement" agency, the Corps of Engineers takes the attitude that it is better to prevent pollution than to apprehend and successfully prosecute violators. Although strict about enforcement, since the law is mandatory, the Corps attempts to secure cooperation in the installation and operation of proper equipment and the promulgation and enforcement of rules and regulations to reduce pollution.

In many cases the Corps of Engineers, and frequently in cooperation with the State Fish and Game Commission, holds conferences or consults with individuals, concerns, or agencies whose operations involve pollution hazards, concerning proper methods and equipment to prevent pollution. The Corps, of course, is not empowered to require installation of equipment or prescribe operating regulations, but it is eager to assist in considering such matters if the persons or agencies involved so desire, which is frequently the case.

One of the latest cases of cooperation on a large scale is in connection with the fish-canning industry at Los Angeles Harbor, wherein all bilge and waste water from the fishing boats and part of the waste water from the canneries

was theretofore discharged directly into Fish Harbor, creating a most undesirable condition. Since the matter of pollution and its prevention has been called to their attention by both the state and the Federal Government, equipment has been installed so that all liquid waste now goes into the sewer system. The importance of keeping oil and solids from the sewers has been emphasized, and screens and centrifuges have been installed for their removal for that purpose. It is interesting to note that, in general, the by-products recovered by these and other installations for eliminating pollution have rapidly paid for the installation cost. Unfortunately, the Fish Harbor pollution is not fully solved, since the waste from the fish canneries, and from boats, which is pumped ashore, is still discharged through a sewer, untreated, into nearby Los Angeles Outer Harbor, causing some pollution.

The cooperation of the major oil companies in preventing pollution has been most satisfactory. Practically all of the oil-loading docks now have special equipment for the prevention of pollution, and some have special booms for use in surrounding oil spills. In some cases, the procedure in loading oil has been modified so as to reduce the liability of pollution, and most companies now carefully plug all vessel scuppers, while in port, in order to prevent oil spilled on deck from flowing overboard. Most oil companies now require their ships' masters to dump bilge and ballast waters at least fifty miles offshore. Crews of vessels and shore facilities are provided with equipment for, and have been instructed in methods of localizing and removing oil spills so that, although pollutions may occur, they will not spread and become a general nuisance and hazard over large areas.

To prevent refuse and garbage pollution, some ships have installed locked receptacles wherein all such materials are placed while the vessel is in port, and which can be unlocked to permit disposal of the material only by responsible employees, who are instructed that refuse shall not be dumped until the vessel is at least eighteen miles offshore.

The Corps of Engineers, in order to inform all persons concerning Federal pollution laws and to call to their attention the need for preventing pollution, has issued notices to all steampship companies, vessel owners and operators, shipping concerns, oil companies, terminal and dock operators, and other agencies whose activities may involve pollution hazards. All such parties have been requested to post and bring these matters to the notice and attention of all employees. Operators of vessels employing foreign crews have been requested to translate and post bulletin notices in the languages of their crews. Some such translations have been made and distributed by the State Fish and Game Pollution Detail.

Our office has also recently published and distributed a twenty-two-page illustrated booket on the subject of pollution and its prevention. This booklet describes the harmful effects of pollution, the causes, and means of prevention, and quotes the pollution laws. It is intended that by illustrating the various facts, the vessels, steamship companies, shipping agencies, and others, would have a convenient means of calling the attention of all employees to the pollution problem, and that cooperation in this matter would thereby be considerably advanced.

I have with me a few copies of this booklet and shall be glad to give a copy to anyone. If there is an insufficient number to meet the demand, a

copy can be obtained upon request, from the District Engineer, U. S. Engineer Office, 751 South Figueroa Street, Los Angeles.

Although in the Los Angeles District new pollution cases average about four a month, the pollution situation is now much improved, the harbor areas are cleaner than a few years ago, and the public beaches are less frequently covered with oil and littered with garbage and other refuse. However, complete elimination of accidents that cause pollution is difficult, and there are still many improvements to be made. The city of Los Angeles still discharges its untreated sewage into the ocean not far from shore, and the city of San Diego discharges raw sewage directly into San Diego Harbor.

It will require continued cooperation of all concerned—vessel operators, shipping interests, and industry in general, especially the personnel "on the ground" and aboard ship, as well as the state and city agencies and in a small way the public in general—to improve the situation so that conditions are satisfactory. It is the hope of the Corps of Engineers that the necessary steps toward pollution elimination may rapidly be accomplished.

Discussion:

Mr. A. M. Rawn:

In presenting Colonel Kelton's paper, Capt. N. A. Mathias has defined the position of the Federal Government, and particularly the War Department, in the national stream pollution picture; and in addition he sets out the rules which regulate disposal of oil and refuse wastes along tide waters. The paper brings to mind the very narrow limits within which the Federal authorities may operate in the matters relating to stream pollution. This matter having come before the Congress at its last two sessions in the shape of a measure known generally as the Vinson-Barkley bill and having been carefully considered by the National Resources Committee's special advisory group on water pollution, it may be of interest to discuss here briefly the present extent of administrative control over water pollution in the United States and measures recommended for better stream and tidewater cleanliness.

Current administrative control over water pollution in the United States is said by the National Resources Committee to classify under four general methods, as follows:

First: "Persons suffering damage from water pollution may obtain compensation for that damage by suing the pollutor and proving a just claim; or they may obtain an injunction restraining further discharge of polluting materials." This, in general, is the common law with respect to riparian ownership. To be effective it must be invoked wisely; else, as the late George Fuller stated, "The plaintiff of today may be the defendant of tomorrow." Mr. Fuller continued: "Its (the common law) shortcomings in practice are related to the expense, trouble and annoyance of instituting legal proceedings to maintain riparian rights. In addition, those proposing legal proceedings at common law may be themselves frequently offenders and liable to proceedings by others; thus automatically restricting actions which ordinarily would be sought both by municipal and private corporations." The N.R.C. report goes on to say: "Once damages are proven, it is necessary before an injunction may be obtained, also to prove that practicable means of abatement exist. This entails further expense and further delay."

So far as the average individual, seeking redress for invasion of reparian rights, is concerned—he is likely to find common law procedure slow, tiresome, expensive and many times ineffective.

Second: The second control is: (2) "All States have enacted legislation authorizing State officials to take some action with respect to pollution. Authorizations range from mere direction to study the extent of pollution in some States, to the exercise of police power to force the treatment of any waste in others."

Mr. Fuller has commented on this general type of legislation as follows: "In all countries having areas densely populated and with small or moderate sized water courses, steps have been sought to reinforce control by common law proceedings through the enactment of statutory provisions. These are founded on the police powers of the enacting authority and are justified by the claim which citizens have on their government for protection of public health and welfare." His statement may very well be extended to many States of the Union where areas are not so densely populated and waterways not so small. Thus we find in the several State health and welfare enactments very definite rules about pollution of water and construction of sewers and appurtenant works. In California the Public Health Act; the Fish and Game Act; laws empowering construction of sewers and appurtenant works by municipalities, sanitary districts, sanitation districts, public utilities districts, and a number of penal statutes are provisions designed to ". . . . reinforce control by common law proceedings." Of all present measures designed to abate or prevent pollution, the State laws are the strongest and most effective. Extended and amplified in some States and revised to a more uniform pattern in all, they will undoubtedly prove our most useful weapon in the continual struggle against insanitary conditions.

The *third* method of administrative control over water pollution is: (3) "One interstate authority has been established to administer a pollution abatement compact in an interstate area; and compacts which would provide for at least two other interstate authorities are in course of negotiation." The one which has been formed is the Interstate Sanitary Commission, New Jersey-New York; two which are pending are the Ohio River Valley sanitation compact and the Potomac compact. There are informal compacts relating to the Delaware Basin and the tri-State Minnesota-North Dakota-South Dakota conferences. Discussing this type of regulation, the Water Pollution Advisory Committee directs attention to the longer periods which may pass before the compacts may be ratified by all participating States; to the fact that due to local influences, administration of the compact rules may be lax in one State and severe in another, and that there is no ready solution to the problem other than the erection of an over-riding authority, probably the Federal Government. The splendid accomplishments of interstate efforts are not to be minimized. Nevertheless, guidance by Federal authorities would doubtless improve progress.

As a *fourth* measure, the Commission states: (4) "The Federal Government directly controls water pollution only insofar as it regulates pollution of coastal waters by oil and that of navigable waters by substances which impede navigation."

Federal regulation in the State of California, under existing law, can be invoked only to prohibit the discharge of oil from vessels into tidal navigable waters and to prohibit the deposit of refuse matter other than that flowing from streets and sewers into navigable waters. In addition, in California the Secretary of War is authorized to supervise the activities of the California Debris Commission organized to regulate hydraulic mining. These regulations, authority for which is derived from the Commerce Clause in the Constitution, offer little in the way of relief from pollution and contamination of streams, lakes and tide waters in California or the other States.

In his discussion, Colonel Kelton has mentioned the United States Public Health Service. Because of its authority to determine the quality or safety of drinking and culinary water used on interstate carriers; and by virtue of voluntary agreements with several States, the U.S.P.H. exercises an indirect control over water pollution and over pollution and contamination in shell fishing areas. The U.S.P.H. is without authority to order remedial measures and must depend upon substantial quarantine to compel abatement.

Regulation of water pollution is now exercised almost wholly by State governments; and, in the opinion of many authorities, should be left there. The N.R.C. recommends that State laws be strengthened, where needful, by the following: State health laws should be drawn to a more uniform pattern so that equal authority is enjoyed by all. Adequate administrative control of pollution, authority and power to determine the nature and extent of pollution, mandatory powers to enforce action necessary to abate pollution, removal of State limitation

on municipal bonding when applied to remedial works ordered by the administrative agency, and delegation of power to organize special sewerage districts are recommended. These measures are deemed sufficient to empower State health authorities to investigate into insanitary conditions and to propose and enforce remedial measures.

New Federal legislation proposed by N.R.C., while it includes no basic changes in Federal law with reference to Federal regulation of pollution, suggests inclusion of the following principles in a future Congressional enactment:

First: (a) U.S.P.H. Service shall be authorized to make studies of water pollution and water pollution abatement. (b) To cooperate with other Federal, State and municipal agencies in such studies; to assist State officials in the formation and administration of interstate compacts; to review and report to the President on the economic and technical feasibility of pollution abatement projects for which Federal financial assistance is requested.

Second: Federal financial assistance is recommended as follows: (a) Grants-in-aid and loans to State or other public agencies. (b) Loans to industry and other non-public agencies.

Third: Recommendations of Federal aid should be made by the Federal agency mentioned in Section 1—preferably the U.S.P.H. The remaining recommendations, three in number, relate to the manner in which recommendations for Federal assistance should be acted upon and cleared through the various governmental agencies.

It seems to boil down to this: the Federal Government, through the War Department, may continue to guard the navigable waters against pollution and obstructions of various sorts as at present; the U.S.P.H. shall continue to regulate drinking and culinary water on interstate common carriers. Congress shall enact new legislation permitting the U.S.P.H. to guide efforts towards antipollution thruout the country, offering participating bodies, where desirable, financial aid from the Federal treasury. Such action on the part of Congress would leave the jurisdiction and control of State waters in the hands of the States where it is deemed logically to belong; would admit of interstate compacts where interstate waters or watersheds are involved, but would provide that where Federal aid was desired an overriding agency, preferably the U.S.P.H., would guide the State activities and insure adequate administrative control. It would undoubtedly have one more effect also: inasmuch as there are few States which would care to refuse grants-in-aid and loans from the Federal treasury, the enactment of such legislation would in all probability result in the enactment of far more uniform, satisfactory and adequate public health laws in each of the several States, as a prerequisite to approval of proposed works by the U.S.P.H.

I believe this topic should command much attention from the Sewage Works Associations of America and that each, after adequate investigation, should express itself upon the proposal made by the National Resources Committee.

If I have shot a little wide of the mark outlined in the topic which Colonel Kelton has so kindly explained, I beg his indulgence on the grounds that his able paper appeared to present an opportunity to acquaint you a little with what is being currently considered in the stream and shore pollution field. So far as I am able to see, he has presented the case from the present standpoint of the Federal Government and the Army Enginers so clearly as to leave no doubt in the minds of his auditors regarding the position of either.

POLLUTION OF SAN FRANCISCO BAY, THE OCEAN SHORE, AND THE EFFECTS OF SEWAGE TREATMENT

By A. B. CROWLEY,
Chief Inspector, Department of Public Health, San Francisco

The City of San Francisco is situated on the tip of a peninsula with the Pacific Ocean on the west and the Bay of San Francisco on the north and east. Being surrounded by water on three sides, the problem of sewage disposal no doubt seemed simple to those who first settled in this area. The establishment of a community at this location was probably looked upon with favor because of the natural advantages available for simple disposal of waste by promiscuous dumping into these bodies of water.

Our first settlers solved their immediate problem by constructing simple drainage ditches to the bay or by disposing of sewage into the natural drainage channels that emptied into the waters of the bay. These people evidently gave little or no consideration to the health hazards that eventually would result. Such tactics, however, were probably frowned upon even at that time by the natives of the territory, who, through severe experiences with nature, seemed to have appreciated the necessity for protection of waterways against human pollution much more than the so-called "civilized or educated man" of the day.

This was the beginning of the pollution of the waters surrounding San Francisco and from that time until the year 1931, the magnitude of the problem grew even more rapidly than the population.

As the community and civic government developed, attention was directed to the simplest and most expedient means of sewage disposal from buildings to the waters of the bay or ocean. Very little consideration was given to future needs. Gradually some semblance of order and planning of sewer lines developed, but still little or no attention was given to anything other than the delivering of sewage to the nearest point of the bay or ocean and discharging same at this point through outfalls so constructed as to deposit the material on the beaches at low tide. There are still outfalls of this type in use in San Francisco today.

Our first settlers and city officials cannot be blamed for such tactics any more than those of other communities situated in close proximity to waterways—all seemed to have made the same mistake.

Such methods of sewage disposal could result only in trouble in the form of severe health hazards, obnoxious esthetic nuisances, and practically complete loss of the use of beaches for recreational purposes. As San Francisco grew, so did the nuisance; rapidly the day of reckoning drew near. The sins of our forefathers gradually engulfed us in a maze of despair and confusion, until anxious city officials realized that something had to be done to stop present insanitary means of sewage disposal and to rectify, as much as possible, undesirable existing conditions.

To do this, however, was not an easy task. First, it was necessary to arouse public sentiment to a point where the majority of the people would be willing to sanction an expenditure of a large sum of money to begin this work.

The antiquity of our method of sewage disposal was fully recognized in the year 1931, at which time we were continually discharging all of our sewage without the slightest degree of treatment at our shore line through thirty-one outfalls. Of this number, nineteen are on the bay shore, eleven on the north shore and one on the west or ocean shore; and there are ten storm overflows that contribute some sewage during the rainy season. Repugnant, dangerous conditions existed in many sections of our shores. All of the beaches, including the fine sandy beach of our Pacific Ocean from Fleishhacker Pool on the south to the Cliff House on the north, and well-protected and attractive beaches at China Cove, Bakers Beach, Marina Beach, Hunters Point and Yosemite Avenue Cove were in such condition that quarantine against swimming in these waters became necessary.

As the result of improper disposal, not only were our beaches ruined for recreational purposes, but rat and fly breeding conditions were favorable in the vicinity of outfalls; odors were at times nauseating; and certain areas popular as promenades because of attractive improvements were surrounded by the disgusting sight of floating solids usually found in shore waters adjacent to large sewer outfalls of this type.

In addition to the conditions just mentioned, undesirable surroundings have had their effect on our shipping industry. Palatial passenger liners berthed at certain piers were within close proximity of outfalls. Under certain tidal conditions, foul odors were definitely noticeable and annoying to passengers. The sight of floating sewage moving quietly by a ship at dock has been cause for adverse comment at many a bon voyage party. In one instance, water conditions due to sewage pollution created a condition that was very detrimental because of gaseous action on the white paint of ships, and an extensive costly engineering survey was essential in order to provide means of minimizing damage.

Aside from being esthetic nuisances and economical factors, these conditions were a constant threat to public health and a serious source of worry to the Department of Public Health. In spite of quarantine orders and even diligent police methods, it was humanly impossible to keep people from swimming in these waters.

The American public has very little respect or patience for warning or prohibitive signboards. Some of our freshly painted quarantine signs were torn dawn and used as fodder for beach bonfires within twelve hours after having been erected. Warning notices on metal signs were so defaced within very short periods that they were not legible and were of little value.

Sun bathers, swimmers and picnic parties constituted our most defiant group and were the source of our main worries. Sportsmen were also a problem but were much more cooperative and patient than the former group and, in fact, indicated a deep sypmathetic attitude toward our problems. They organized definite action among their own members to stimulate interest throughout the entire city, and aided in bringing about remedies.

The fishermen of this latter group, who enjoyed surf casting along our beaches, were exposed while in pursuit of their pleasure to conditions that were such as to be a possible source of infection. I have seen fishermen casting from shore in certain beaches and as lines were continually reeled in, rods, reels ,hands, clothing and other equipment were saturated in short order

with sewage from the water. The dangerous situation presented by such conditions was magnified by the fact that most of these people carried cold lunches, consisting largely of sandwiches, and no safe water was available for washing their hands.

The transmission of disease by this medium is by no means a myth or an exaggeration of facts. During the year 1938 four cases of typhoid fever were traced to exposure of this nature. These illnesses occurred in young children who had been allowed to play in a certain section of sandy beach known to be polluted by sewage. After the second case had been reported and our investigations were under way, efforts were doubled when two more cases were reported in rapid succession.

Briefly, our findings were that a plumbing contractor had connected a side sewer to a storm water outfall. The particular building involved was so constructed that all plumbing fixtures were properly drained to the street sewer in the front of the premises with the exception of a wash basin, toilet and shower, all in the servants' quarters in the rear of the building. The fixtures in the servants' quarters were so situated as to require pumping in order to drain to the front of the building, so the plumber adopted the simple expedient of draining these fixtures by gravity-flow to the convenient storm sewer in the rear. The family was away on an extended vacation and the only occupant of the premises was a Chinese servant who lived in the servants' quarters. This man was in the habit of inviting a group of friends from Chinatown to the house to play cards several evenings each week. All were allowed to use the toilet in the servants' quarters. The house servant was hospitalized and closely examined for the possibility of being a carrier but proved to be negative. There were so many friends who had visited the house, and a large number whose residences were unknown to the servant, that we were unable to bring this part of our investigation to a satisfactory conclusion. The fact remains, however, that there were no further cases of typhoid fever after this sewer line was disconnected and we know from observation that children were allowed to play on the same beach after this occurrence.

Cognizant of deplorable existing conditions, Doctor J. C. Geiger, Director of Public Health, outlined and directed a plan, whereby public interest and indignation could be gradually but sufficiently aroused.

Our program was inaugurated in 1931 by warning notices and other publicity in our daily papers, the nature of which was very detrimental to the popularity of our beaches. Needless to say, the truth about our heavily polluted beaches was received with skepticism by some, while others were quite alarmed, and some just nodded their heads in an understanding manner and expressed themselves as being hopeful that some action would be taken to relieve conditions. Quarantine regulations were strengthened and more stringently enforced. Such activities resulted in many calls upon the Department for information as to the safety of certain beaches where people were desirous of taking their children for an outing. When informed that it was not safe to use the beaches, the public seemed genuinely disappointed. Many caustic comments were directed at city officials and it was evident that our truthful propaganda was working well and the public finally was awakening to the seriousness of a problem that was the responsibility of every resident of San Francisco.

After due consideration it was decided to conduct a survey that would reflect the conditions of the water along the west and north shores. Eighteen sampling stations were carefully selected and samples of water were obtained at least once each week for a period of one year. It was concluded that if adequate samples were collected at a sufficient number of places all conditions of pollution as affected by tides and winds eventually would be represented.

The best criterion of sewage pollution has long been recognized to be the presence of members of the coli-aerogenes group of bacteria. Under the existing circumstances it was believed that the positive presumptive presence of this group of organisms would be sufficient. The relative numbers could be ascertained by thus determining the positive presumptive presence of the bacteria in question in varying amounts of the collected samples. This was done by using the following quantities: 10, 1, 0.1, 0.01, and 0.001 c.c. If, for example, the organisms, E. coli, were demonstrated in one one-thousandth of a cubic centimeter of a given sample, then it could be assumed with propriety that at least 1000 were present.

In practice two tubes of each so-called dilution were employed. These were incubated at body temperature, 37° C., and the presence of gas formers observed. The medium, lactose broth, was devised to indicate the presumptive presence of organisms of the coli-aerogenes group. If, at the end of 24 hours' incubation, gas occupying 10 per cent or more of the inverted vial in a fermentation was formed, it was considered to constitute a positive presumptive test. The work was performed in accordance with the "Standard Methods of Water Analysis" of the American Public Health Association and the American Water Works Association.

The eighteen sampling stations that had been selected were located between the Funston Life Guard Station on the Pacific Ocean (southwest boundary of San Francisco) and Pier 45, east of Fishermen's Wharf, on the northern shore of San Francisco Bay.

The distance between the sampling stations varied from 1800 feet to 6300 feet and averaged somewhat less than 3600 feet. The total length of shore line covered was about 11.5 miles. In this stretch are located three main sewer outfalls of the City; namely, from east to west, Pierce Street, Bakers Beach, and Mile Rock. In addition, the Laguna Street sewer contributes a considerable volume of sewage. There are also three important storm overflows: at Laguna Street, Baker Street, and Bakers Beach. Furthermore, there are one or two minor sewer outfalls maintained by the City, and several by the United States Government in the Presidio Military Reservation and Fort Mason.

The sampling was conducted weekly for one full year, from February 6, 1933, to February 7, 1934. There were 52 sets of samples, nearly all of which covered all stations. The samples were collected by an Inspector of the Industrial Division. The work of collecting a single series of samples ordinarily consumed two days because of the distances to be covered and the difficulty of reaching some of the stations. The collection of samples was 98.7 per cent complete. On rare occasions, a station was omitted for good cause.

This study resulted in findings that indicated serious bacteriological contamination at all stations, particularly along the entire north shore line. The

greatest concentration of sewage bacteria was found along the Marina, Bakers Beach and in the vicinity of Mile Rock Outfall.

The results of these studies are indicated in Fig. 1.

After this comprehensive study, the Department of Public Health had positive evidence of the degree of pollution existing in waters along the westerly and northerly shores, where the most frequented and popular bathing beaches are located. It was no longer necessary to guess at conditions, nor could the public continue to question our knowledge of the extent of pollution.

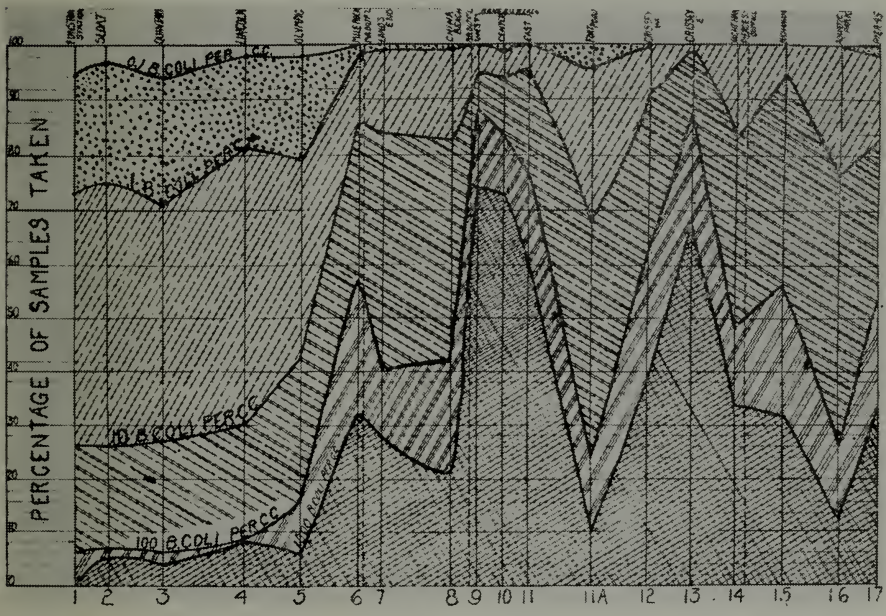

FIGURE 1.

We then extended our program of dissemination of propaganda against the use of beaches, and succeeded in interesting most of our civic organizations. The members of these groups, being presented with all of the facts involved, took it upon themselves to spread the news among the residents of the various negihborhoods. After it became certain that the topic of sewage pollution and sewage disposal was one of common gossip amongst our people, we were confident that our long period of careful planning and strategy had reached a point where we were ready to ask the residents of San Francisco to take definite action.

Consequently, a bond issue of $2,625,000 was prepared and presented to the people, who in turn voted favorably by a substantial plurality. We were then in a position to start the tedious process of correcting our errors.

Responsibility for the expenditure of these monies was placed with the Department of Public Works. Realizing the mistakes that had been made

in the past, and that we were about to enter into a new phase of sewage disposal for San Francisco, careful consideration was given to proper planning of the means of correction. As a result, the Director of Public Works appointed a committee of engineers on July 25, 1934, to investigate and report with estimate of cost upon the most economical and reasonably effective method of disposing of the sewage at Bakers Beach and the Marina, through sewage disposal plants, which were to be erected out of Federal Works Administration funds. This committee consisted of Messrs. Harrison P. Eddy, Charles Gilman Hyde, Clyde C. Kennedy and Leon B. Reynolds.

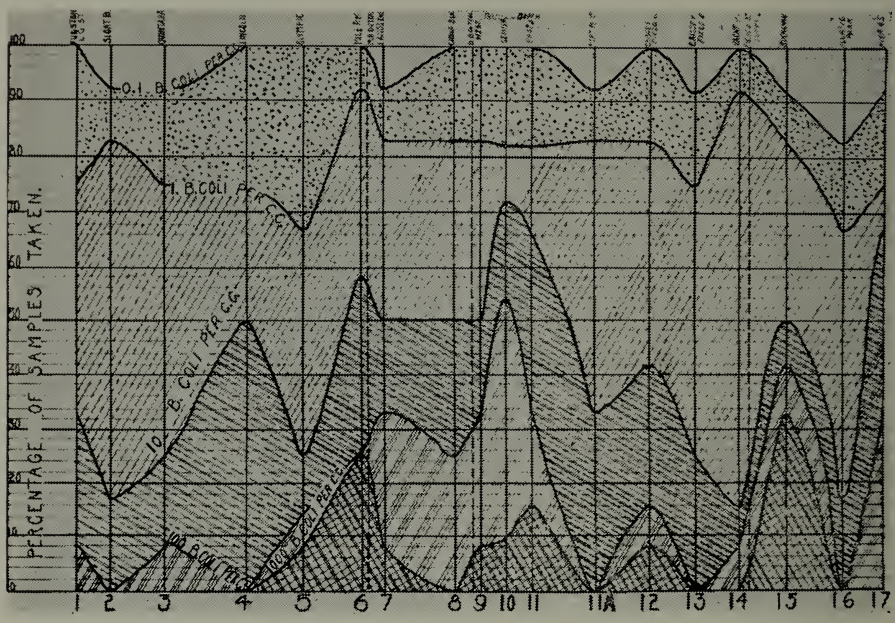
PERCENTAGE OF SAMPLES TAKEN.
0.1 B. COLI PER C.C.
1. B. COLI PER C.C.
10 B. COLI PER C.C.
100 B. COLI PER C.C.
1000 B. COLI PER C.C.
1 2 3 4 5 6 7 8 9 10 11 11A 12 13 14 15 16 17

FIGURE 2.

On May 6, 1935, a very comprehensive report was rendered by the committee to the Director of Public Works. Shortly thereafter negotiations were entered into with various governmental officials to start construction in accordance with the recommendations of the committee of engineers. The result was that on August 1, 1939, our first sewage disposal plant was placed in operation. This plant has eliminated all outfalls from Bakers Beach to the Funston Life Guard Station, our southwest boundary, with the exception of a small flow of sewage at Bakers Beach which will necessitate a pumping plant to lift the sewage into the present mains leading to the sewage disposal plant. Funds are now available for this work. Several small sewers servicing the Presidio Military Reservation are being reconstructed at present and will be intercepted by our San Francisco lines.

In addition to the sewage disposal plant, an underground pumping plant has been erected on the north shores at Marina Park. This pumping plant

moves all sewage from our north shores to the north point outfall at Pier 37. A small amount of sewage is still being emptied in the vicinity of the Aquatic Park, but this is trivial and can and will be corrected within a short time.

When the disposal plant was put into operation, we again started to take samples of water from the same eighteen stations that had been used in the original survey in 1933-34. Because we could not gather the quantity of samples taken in 1933 and 1934 before presenting this paper, it was decided to take samples at each station during various stages of the tide—from full flood to full ebb. In all, 216 samples were taken.

The charts represent bacteriological conditions of shore water as they were prior to sewage treatment and diversion (Fig. 1), and conditions as they are since changes have been effected (Fig. 2). The improvement in the condition of our waters is definitely noticeable and is a source of gratification to all city officials.

A particularly interesting factor which indicates conditions since our plant has been in operation is the variation in extent of pollution, being directly proportional to the operation of the disposal plant. This is mentioned because of the fact that during the time our samples were taken in the month of August, the plant had to be shut down on several occasions, but the Department of Public Health in collecting its samples was not aware of this fact. I feel that the results obtained are of much more interest and value than if the plant had been operating continuously.

Evidently results so far obtained are of such value as to be a deciding factor in obtaining additional funds to carry out the recommendations of the committee of engineers for the completion of the present problem, and to institute studies for the erection of additional plants to care for conditions on our easterly shores.

We of the Department of Public Health are well satisfied with the improvements already obtained and the Department of Public Works, through its engineering staff, is working very smoothly with the Department of Public Health in rapidly rehabilitating our beaches.

States, municipalities and industries may just as well realize now that they can no longer continue to dispose of sewage promiscuously. The longer that the day of reckoning is postponed, through either sheer ignorance or by obstructionists, the more costly will be the means of correction. For two years I have been chairman of the pollution committee of a State-wide organization of sportsmen, and have had the opportunity to discuss sewage problems before clubs in almost every section of California. This experience has proven that it is unfortunate but true that certain communities, because of disinterested officials, seem to give little or no thought to this problem. A great many officials shudder when the question of a sewage disposal plant is discussed. They seem to feel that the cost of such work is so great that increased taxes might irritate the voters and that these officials may not be returned to office because of this fact. I say with confidence to all such men, that if they properly and thoroughly acquaint their citizens with the problems confronting them, and popularize the subject of sewage disposal, and even go out before the public for re-election on a platform of advocacy of the improvement of beaches and aquatic recreational areas by means of a system of sewage disposal, that they can practically guarantee to themselves re-election on the basis of such a campaign.

The American people today are fully aware of the errors in sewage disposal and conditions resulting from same in the past, and they can readily be made conscious of the necessity of a clean-up in their own area.

San Francisco is well on the way toward complete abatement of existing nuisances. We hope that, in the very near future, we may be able to say that all of our sewage is properly treated before being disposed of into the waters surrounding our community.

I should like to express my appreciation to Professor Charles Gilman Hyde, Consulting and Sanitary Engineer, San Francisco Department of Public Health, for the advice and help given to me in the preparation of this paper.

Discussion:

Mr. J. F. Byxbee:

Mr. Crowley's paper describing the sanitary improvements that San Francisco has made during the last several years in regard to reducing the raw sewage pollution of San Francisco Bay and the Ocean Shore, particularly along the northerly and westerly shore lines of the city, is very interesting. The campaign carried on by the Department of Public Health of San Francisco to educate the citizens to the point of voting the necessary bonds to clean up beaches was evidently conducted in a very forceful and intelligent manner. Other health departments and engineers in this state having similar problems could no doubt profit by reading the historical account given in the paper of the development of sewage treatment in San Francisco.

The great improvement in the condition of the shore water due to the operation of the disposal plant since it was put into service in 1939 has been a source of gratification to the city officials. Also, from the financial aspect, I am of the opinion that the city's taxes will not be raised due to the increased cost of operating the sanitary sewerage system on account of the construction of the treatment plant. I am a property owner in San Francisco and thus far have not noticed any increase in taxes on account of the construction of the sewage treatment plant and pumping station.

When the sewage treatment plant and new outfall sewer were constructed and put into operation in 1934 in Palo Alto, a city of some 16,000 inhabitants, it was found necessary to increase the budgeted allowance for the sewerage division over $10,000 per year. But this did not affect the tax rate. At that time the rate was $1.20 per $100.00 of assessed valuation. Several years later the rate was actually dropped to $1.00 and now it is only 95 cents. The normal increase in property values of a growing city usually absorb in a very short time the additional cost necessary to maintain proper facilities for the treatment of sewage and other wastes that come from a city.

I feel certain that there is no valid reason for cities in California to be lax in properly disposing of waste matter, yet there still is an astonishing amount of indifference on the part of city officials, including health officers and engineers, to the importance of sewage treatment, even in cases where the pollution of waterways by raw sewage is extremely offensive and dangerous to the communities themselves.

For a number of years past I have been greatly concerned regarding the future of San Francisco Bay and the inland waters joined with it which include mainly the San Pablo and Suisun bays and the two large rivers, the Sacramento and the San Joaquin. These waters, including the channels in the delta region, cover roughly an area of 550 square miles, and the shore line distance reaches the amazing figure of some 1200 miles. These figures refer particularly to what might be considered the navigable portion of the streams and the tidal basins of all open water areas.

San Francisco Bay, its tributaries and the surrounding country together make a scenic spot which for size and beauty probably cannot be surpassed anywhere in the world. It is true that there are many places where the scenery might be more rugged and considerably grander, but the bay region scenery is certainly quite varied and pleasing to the eye.

When the white men first came to this region they discovered this beauty and told the world about it. They also mentioned the great quantities of wild game in the hills and the fish and beaver in the streams. The country surely must have been a paradise to nature lovers and to the hunters and fishermen of that period. Later the white race came here and multiplied so that the population grew rapidly until now nearly all of the inhabitants in central California live in the bay region and along the two rivers. The advent of this population has thus far had a very deleterious effect on this region, even though the bay and the surrounding country are of considerable magnitude and can stand a great deal of misuse. First the hunters came and removed practically all the wild life from the hills and valleys within the short period of 50 years. Second the gold seekers attempted to remove a considerable portion of the Sierra Nevada Mountains into the waterways by their methods of hydraulic mining in an effort to find gold. These miners paid no attention to the fact that the washed out materials finally settled in San Francisco Bay and produced vast areas of objectionable mud flats, and also filled in the channels of important rivers.

This state, particularly the bay region, has been damaged far in excess of the value of the gold removed by the hydraulic mining, and the bay region has been permanently damaged due to those operations.

The next tragic event happened when the urban districts growing up along the bay shore and in the drainage basins of the rivers adopted sanitary sewerage systems for the disposal of sewage so planned usually as to discharge the raw sewage into the bays and rivers. Of course when these cities and towns were small, the discharge of the rather limited amount of raw sewage into the bays did not appear to be serious when one considers the vast volume of water in the bays and rivers available for dilution. This situation is changing rapidly, however, and we now find all of the large cities and small towns throughout the region discharging great quantities of raw sewage into the waterways. Nature is still diluting and purifying these wastes in a big way, but it can no longer do a good job. A dirty sewage scum, which is gradually widening, is forming along the shores of the bay. The rivers, sloughs and estuaries are in some places badly polluted with sewage that spreads in very noticeable amounts clear across the width of the streams. About the only places left that still are not seriously polluted are portions of the bay where the channels are deep and far removed from outfall sewers.

The unfortunate thing about the shore line pollution is that our people by the thousands use these shores for recreational and commercial purposes, and most of this use is along the water fronts of large cities where the sewage fields are most noticeable.

I am interested in using the bay and river waters for recreation purposes, yachting and fishing, and have been so for the last 15 years. I have noticed the rapid spread of pollution and the general deterioration of the waters with great consternation. On several occasions I have taken samples of the water from different places such as at the Redwood City Harbor, Palo Alto Harbor, Alviso, Oakland Estuary, at Sacramento, Stockton and Steamboat Slough and along the San Francisco waterfront, and have had these samples analysed. The results indicated waters dangerous to health in all cases. In spite of this I find most of the swimming going on in waters where the bacteria count was highest. How our young people who use these waters manage to keep as free as they do from water-borne diseases is a mystery to me.

I contend that the time has come when we should cease making a great cesspool of the bay and rivers and treat these wonderful waterways not as convenient dumping places, but as natural assets for commercial and clean recreational usage which we must maintain for ourselves and posterity. Sanitary

science and engineering have developed to a point where it is easily possible to stop this pollution, and the cost is not so great as to prohibit any of our intelligently. operated cities from undertaking that very important task.

Discussion:

Mr. Ben Benas:

At the present time between 30 and 60 pounds of chlorine per million gallons is being used for post chlorination, and now that the results of Mr. Crowley's studies are available the chlorine dosage will be increased. There is still some raw sewage being discharged at Baker's Beach from the Sea Cliff area and at Mile Rock from the Great Highway area. During the coming year the Sea Cliff sewage will be pumped to the tunnel and to the Golden Gate Plant, and possibly the sewage from Great Highway area will also be carried to the plant.

Mr. Ted Gregory:

Are there any case records of dysentery from sewage upon the beaches?

Mr. A. B. Crowley:

A record of the cases reported has been kept, but no attempt has been made to trace down the sources. There are many missed cases.

Mr. C. G. Gillespie:

The source of disease cannot always be definitely determined. A shore study by questioning of sportsmen and fishermen on the western waterfront indicates that none have had typhoid. This area has not had a typhoid epidemic, but there is always a chance of an occasional carrier.

Mr. Harold F. Gray:

We must be rather guarded in making statements as to the possibility of contracting enteric disease via bayshore and ocean beach pollution. Direct and explicit epidemiological evidence of such disease transmission is remarkably scarce; it is therefore in my opinion a serious mistake to attempt to frighten people into cleaning up bay and ocean waters by fear of disease, when in fact such danger either does not exist, or cannot be proven by ascertained facts of such disease transmission. We will weaken the legitimate reasons for improvements in sewage disposal by presenting unsound and possibly fallacious arguments.

We have not been able to discover any cases of typhoid fever or dysentery traceable to infection along the East Short Highway, even though the organism of typhoid fever has been isolated from Berkeley sewage. So far as I have been able to find out, no member of any of the University of California crews have ever contracted typhoid fever by infection with the grossly polluted water of the Oakland Estuary, on which they practice, though to my personal knowledge they have practiced there since the spring of 1904. And if you want to go back into history, you will find that the years of the Great Stink in London, in 1858 and 1859, due to gross pollution of the Thames River, were exceptionally healthy years, the bills of mortality showing a lower death rate than either the immediately preceding or following years.

Mr. Morris Cohn:

Are there any sludge deposits along the shores from which sewage has been removed? The rapid reduction in bacteria count would indicate there were no sludge deposits.

Mr. Ben Benas:

No definite studies were made to determine the presence of sludge deposits.

Mr. Clyde C. Kennedy:

The San Francisco sewer outlets for the main part were in or close to good currents; therefore, it was presumed that sludge banks were very limited in extent, or absent.

Mr. A. C. Beyer:

During 1937, under the direction of the State Board of Health, extensive field tests were carried out to determine the effect of chlorination of raw sewage discharged through the City of Monterey outfall into the adjacent bay. A thorough bacterial survey before and after chlorination, showed a decidedly marked reduction in B. Coli counts after chlorination of the raw sewage.

POLLUTION OF STATE WATERS FROM THE VIEWPOINT OF SPORTS ENTHUSIASTS

By HOWARD VERNON

Not many years ago the waters of the State of California presented to the sportsmen a veritable anglers' paradise. For a while so abundantly beneficent was nature that the conservation of wild life within the State of California was neglected. During recent years, however, because of the efforts of the sportsmen of California and the fish and game columnists of the different newspapers, laws have been passed calculated to prevent the wanton destruction of fish and game. Today, because of the settled condition of the commonwealth, the increase of population and the extension of agricultural projects, many of those who seek their recreation from the sports have been driven to the interior streams and waters of the State for their pleasures. Sewage, refuse and trade waste, generally, from communities, have made it necessary that some means be provided for preserving the purity of the natural haunts of the fish and game of the State.

The unchecked accumulation of sewage in the streams, inlets and bays of the State presents to the sportsmen a most alarming condition. The question is, in view of the rapid increase of pollution, are we going to preserve the purity of the State waters and, at the same time, guard the health of our citizens and preserve to the sportsman angler the joys which our bays and streams afford? In order to make the State most liveable, it is just as necessary that the purity of the waters of the State be preserved as it is that cities and towns be kept clean. It is, of course, well known that one of the best safeguards against disease is cleanliness and that where polluted streams, rivers, estuaries, inlets and bays are found in settled communities there is the gravest danger of disease. Thus it will be seen that sanitation and true sportsmanship go hand in hand. The thoughtless sportsman really goes afield not alone for the pleasure he derives from rod and gun, but also because he knows that fishing and hunting are health giving recreation.

The people of California are fortunate in having among their fellow citizens skilled engineers, who are capable of handling the problems of sanitation that have caused the coming together of the members of this convention. The sportsmen of California know only too well the value of the work that the experts upon this subject have done and the necessity for encouraging them to further efforts.

The modern sewage disposal plants which have been installed at Healdsburg, Petaluma, Burlingame, San Mateo, Palo Alto, Santa Clara, San Francisco, and elsewhere, in this State, are examples of the magnificent work that is being done, and those who have achieved these results deserve the praise of our citizens.

If the general public were cognizant of the filth that flows from the sewers into the bays and streams of this State, the resultant effect undoubtedly would be a combined move toward remedying the awful conditions that exist. It is possible that the flow of this filth from the sewers is to go on until an epidemic breaks out? That surely will be the result before long if the present conditions are not remedied.

Not long ago refuse oil was discharged from steamers, small craft and different plants into San Pablo Bay, and because of that fact striped bass and shell fish ceased to be edible on account of the taste of this refuse oil in the bass and shell fish. Wild ducks, covered with this refuse oil, were unable to take wing and finally died. On account of this the authorities took the matter in hand, many arrests were made, and because of the imposition of heavy fines the discharge of this refuse oil into the water has practically ceased. On August 2, 1939, Hon. A. F. St. Sure, Judge of the United District Court, imposed a fine of one thousand dollars upon a second offender for polluting the Oakland estuary with oil he discharged from an old ferryboat which he had just purchased. Fines of this character have a most salutary effect upon such offenders.

In passing it may be interesting to know that other lands are also active in preserving the purity of their waters. For instance, inland towns in Great Britain are compelled to adopt some form of purification as the Rivers Pollution Act forbids the entrance of raw sewage into streams. (From Encyclopedia Britannica, 14th edition, 1929, vol. 20, page 402.)

About May, 1936, a sample of water was taken from the Napa River. The sample, upon analysis, indicated heavy pollution. I leave to your imagination what the condition of that water is at the present time. There are at least fourteen sewers emptying into the river from the City of Napa and one from the Napa State Hospital. There was an effort made Sept. 29, 1938, on the part of the people of the City of Napa to have a bond issue voted to defray the expense of the installation of a modern sewage disposal plant. Twenty-three votes less than the required two-thirds majority spelled defeat for the measure. The vote was: 1,343 yes; 706 no.

In Marin County there are many sewers that deposit their filth in the streams which empty into San Francisco Bay. Nothing has been done to remedy this malodorous and unhealthy condition.

East Bay municipalities recently decided $15,000,000 was entirely too high a price to pay for the installation of modern sewage treatment plants to prevent the pollution of the water along a part of the East Bay shore.

As an instance of what has been accomplished for the sportsman by the establishment of a sewage disposal plant by the City of Petaluma, I call your attention to the fact that since this plant was installed, the striped bass for the first time in years have come up Petaluma Creek as far as the City of Petaluma in goodly numbers. Is not this alone a justification for the expense incurred by that enterprising city, without mentioning the other benefits accruing?

Suppose the City of Napa and the State Hospital could be induced to take similar measures. Would not the striped bass in that event again resume their habitat in the upper Napa River? Would it not then be safe to consume shellfish and crabs found in the vicinity? Would we not feel more assurance that the ducks shot on the Sonoma marsh were fit for human consumption? Could we not trust our boys and girls to go swimming in the warmer waters of the Napa River and its branches without being afraid of their contracting typhoid fever through contact with the polluted waters? Will not the preservation of the health of our people when engaged in healthful sport in unpolluted waters justify any expense necessary to make and keep these waters unpolluted?

Could not the same thing be said of the waters of Oakland Creek and Bay Farm Island nearer to where we now are?

As a striped bass enthusiast, I had called to my attention that in Oakland Creek certain anglers had selected the mouths of certain sewers as favorite fishing grounds because they claimed, perhaps rightly, that the fish congregated at the mouths of these sewers to feed on the filth were fatter than those caught elsewhere. Is such a condition in the heart of this great city a pleasant one to contemplate? Is not the expense necessary to correct it justified by every human consideration?

Surgeon-General Thomas M. Parran, Jr., Director of the United States Public Health Service, on August 26th last told officials of East Bay cities that the polluted condition of the east shore line was a very filthy situation and one of the most serious of its type in the United States.

Mayor Henry A. Weichhart of Alameda, President of the East Bay Municipal Executives Association, said that $60,000.00 has been pledged by the East Bay cities for a survey there within the next two or three months. Let us hope that this survey is followed up by the installation of modern sewage treatment plants to remedy the deplorable condition that now exists there.

The San Jose main outfall sewer is a receptacle for the filth from many sewers thereabouts, and that sewer discharges its sewage into a slough that flows into San Francisco Bay.

The seeming indifference or apathy of the populace of various California cities and towns, in regard to the pollution of our waters, must be due to ignorance of the true facts concerning public health and fish and game life.

Mr. J. N. "Ding" Darling, President of the National Wildlife Federation, at a New England game conference in 1938, said: "Pollution has turned your rivers into sewers, once flourishing forests are gone, abandoned farms monopolize your countryside and you have to hatch fish and game birds in incubators because they can't exist in what you have left them of natural environment."

In a recent issue of the "Municipal Sanitation" appeared the following: "Buffalo's City Judge, Charles T. Yeager, has found a method of teaching traffic violators to use caution in their future driving. We recommend the use of this system in the sewage treatment field. When Judge Yeager took the Traffic Court bench every reckless driver was taken to view the city morgue to see the maimed victims of such accidents. It would be equally effective to force all citizens who vote against sewage treatment to take a dip in the polluted waters below the sewers, which would have been intercepted for treatment, had their votes been properly cast." Well said!

The solution of this problem is undoubtedly clear to those who are possessed of expert knowledge in the premises, but in order that practical application of this knowledge may be made it is, as I have suggested, necessary that the people who, after all, are the source from which the necessary expense must flow, be educated to an understanding of the crying necessity for sanitation, and the profits in health, in pleasure and in dollars, which the expenditure of adequate sums of money for the purification of the waters of the State will bring to them.

Section 481 of the Fish and Game Code reads as follows:

"Pollution of waters: Substance deleterious to fish, plant or bird life. It is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of this State, any petroleum, acid, coal or oil tar, lamp black, aniline, asphalt, bitumen, or residuary product of petroleum, or carbonaceous material, or substance, or any refuse, liquid or solid, from any refinery, gas house, tannery, distillery, chemical works, mill or factory of any kind, or any sawdust, shavings, slabs, edgings, or any factory refuse, or any lime, any cocculus indicus, or any slag or *any substance or material deleterious to fish, plant life, or bird life.* (Enacted 1933.)

In conclusion, I will say, it is my fond hope that all the officials and people of the different cities and towns of California will join in a concerted movement to stop the pollution of the waters of this Commonwealth, to the end that this great State may again enjoy an unquestionable reputation for the cleanliness of its waters and a most healthful place to live and that fish and game may increase and thrive.

NOTES

From the Files of the Secretary

We hope the operators turn out for the spring conference at Catalina. Of course it takes a boat to get there, but think of being able to get your favorite sources of information in a corner—you know they can't get away.

The Chairman of the Publicity Committee has prepared a scrapbook of clippings regarding Association affairs which is most interesting and valuable; perhaps he will have it available at the next meeting for the members to look over.

Each year the Association receives several invitations to hold its meetings in various California cities—Riverside, San Francisco, Santa Cruz, and Santa Barbara have issued such invitations this year.

Occasionally the Secretary receives a letter asking for information about treatment plants, costs, etc. We may not know the answer, but we are always glad to contact those who do. As a clearing house for information the Association can render a real service to its membership.

The New York State Sewage Works Association met January 18-20, 1940, in New York City. Aside from a most interesting program covering stream pollution, flocculation without chemicals and corrosion resistance to metals in treatment plants, a beefsteak supper, smoker, and entertainment were underlined. We hope the meeting fulfilled its promises.

Did you know that the New Jersey Sewage Works Association held its first meeting in 1915? The Silver Anniversary meeting will be held March 20-22, 1940, in Trenton, New Jersey. Members of our Association have been issued a most cordial invitation to attend.

Items of Interest

We have notes on a few of the operators at various plants in the State. If you aren't mentioned, it is because you didn't tell us about it.

Carl Unger, at the new Petaluma Treatment Plant, is a new member.

J. B. Wirt is operator of the new San Leandro Plant and has recently joined the Association.

W. K. Adams, City Engineer of Redding, and L. C. Webb of Gridley have recently joined the Association.

F. Wayland Jones is now Superintendent of the Stockton South Plant, and Frank Faccini has taken Jones' place as chief operator of Stockton North Plant.

Finlay J. Norris is now operating the Whittier Plant.

J. H. Farrar, operator of the Ontario Plant, has recently joined the Association.

Up the Ladder to Fame

Three charter members of the California Sewage Works Association, namely, Messrs. Charles G. Hyde, Harold F. Gray and A. M. Rawn are being considered for appointment to a Board of Consulting Engineers on Sewerage and Sewage Disposal for East Bay Cities.

Charles H. Lee, a member since 1929, has been awarded the Norman Medal of the American Society of Civil Engineers for his paper on "Selection of Materials for Rolled-Fill Earth Dams."

CONSTITUTION AND BY-LAWS OF THE CALIFORNIA SEWAGE WORKS ASSOCIATION

AS AMENDED SEPTEMBER, 1939

CONSTITUTION

ARTICLE I

Name

The name of this association shall be CALIFORNIA SEWAGE WORKS ASSOCIATION.

ARTICLE II

Object

The object of this Association shall be the advancement of the fundamental and practical knowledge concerning the nature, collection, treatment and disposal of sewage and industrial wastes, and the design, construction, operation and management of sewage works in California, through the interchange, between members of the Association and with others, of information, experience and opinion relating thereto.

ARTICLE III

Membership

Membership shall be of one kind only—to be known as members. Any person, or any Board, Commission or Department interested in the objective of this Association, or any person engaged in the sale or manufacture of

sewage works equipment, may be a member of the Association. Each membership shall be entitled to one vote.

ARTICLE IV
Officers

The officers of the Association shall be, a President, two Vice-Presidents, designated as First and Second Vice-President, a Secretary-Treasurer, and five Directors. These nine officers shall constitute the Governing Board of the Association.

ARTICLE V
Amendments

Amendments to the Constitution may be made by a two-thirds vote of the members at the annual meeting, after notice of the proposed amendments shall have been mailed to each member in advance.

BY-LAWS

ARTICLE I
Members

Section 1. All members of the preliminary organization shall be members of the Association, without election.

Section 2. Application for membership in the Association shall be made in writing to the Secretary-Treasurer and the applicant must be accepted by a majority vote of the Governing Board as a prerequisite to membership.

Section 3. Any member may be expelled from the Association for cause by two-thirds vote of the Governing Board.

Section 4. Any member may retire from membership by giving written notice to that effect to the Secretary-Treasurer.

Section 5. Any member whose dues are in arrears shall be dropped from membership by the Secretary-Treasurer, provided that any member who has been dropped from membership for non-payment of dues may be reinstated at any time within one year by the Secretary-Treasurer upon payment of current dues.

ARTICLE II
Dues

Section 1. Annual dues shall be two dollars, payable in advance on October first, to cover the succeeding fiscal year. Dues are in arrears on February 1st following the annual meeting.

Section 2. The fiscal year covers the period between January 1st and December 31st.

Section 3. Of the annual dues, one dollar and fifty cents shall be paid to the Federation of Sewage Works Associations for membership in the Federation and shall entitle the member to a copy of the Federation publications for the fiscal year covered.

Section 4. Any member whose dues are delinquent shall not receive publications of the Association or Federation until such dues are paid. Any member who shall have been reinstated to membership, as provided in Article 1, Section 5, of these By-Laws, shall then be entitled to receive such num-

bers of the Association or Federation publications as may have been withheld on account of non-payment of dues, provided such publications are still available.

ARTICLE III

Section 1. Officers of the Association shall be elected from persons holding individual memberships in the Association.

Section 2. The President, First and Second Vice-Presidents and the Secretary-Treasurer shall be elected to serve from the close of one annual meeting until the close of the next annual meeting.

Section 3. Directors shall be elected to serve for a term of five years each, except as follows: At the first annual meeting in 1928 there shall be five Directors elected: One to serve for one year, one for two years, one for three years, one for four years and one for five years, and at each annual meeting subsequent to the annual meeting of 1928 there shall be one director elected to serve for five years. A year shall be taken to mean the time elapsed from the close of one annual meeting until the close of the next annual meeting.

Section 4. No elective officer, excepting the Secretary-Treasurer, shall be permitted to succeed himself in office but any officer shall be eligible for any other office.

Section 5. The First Vice-President shall succeed the President in case of vacancy in the office, and other vacancies shall be filled by appointment by the Governing Board, appointees to hold office until the next annual meeting of the Association, at which time any unexpired term of office shall be filled at regular election.

Section 6. The President shall have general supervision of the affairs of the Association, subject to the direction of the Governing Board. He shall preside at all meetings of the Association.

Section 7. The Governing Board shall have full control of the affairs of the Association, subject to the acts of the Association in regular meetings. The President shall be Chairman of the Governing Board and preside at all meetings. The Board shall meet at the call of the President and shall hold a meeting just prior to the opening of the annual meeting of the Association. All questions before the Governing Board, except that of expulsion, shall be decided by a majority vote. Five members shall constitute a quorum. The Governing Board shall also vote by letter ballot at the request of the President, which vote shall be conclusive provided a quorum votes.

Section 8. Not less than 30 days after the annual meeting the President shall submit to the Governing Board the names of all committeemen for the ensuing year and the Governing Board shall decide upon their selection prior to appointment.

Section 9. It shall be the duty of the Secretary-Treasurer to attend, and to record the proceedings of, all meetings of the Association and of the Governing Board. He shall also attend to the collection of all dues and money due the Association and shall prepare all claims against the Association for payment and shall pay the latter upon approval thereof by the President.

Section 10. The officers of the Association shall not incur any liability on behalf of the Association except with the approval of the President and not in excess of the amount actually in the treasury. At the annual meeting,

the Secretary-Treasurer shall make a report of the financial condition of the Association.

Section 11. The Governing Board shall appoint two representatives of this Association to serve on the Board of Control of the Federation of Sewage Works Associations. Each representative shall serve for a period of two years with overlapping terms, one representative being appointed at each annual meeting to serve for the next two calendar years. Vacancies shall be filled by the Governing Board. Representatives on the Board of Control shall attend all meetings of the Governing Board, and participate in discussions, but without the right to vote.

ARTICLE IV

Meetings

Section 1. There shall be an annual meeting of the Association, the time, place and duration to be determined by the Governing Board.

Section 2. Spring Conferences and special meetings may be held at such times and places as may be determined by the Governing Board.

Section 3. Ample notice of all meetings shall be given each member by mail.

Section 4. A registration fee of twenty-five cents, when declared necessary by the Governing Board, shall be collected at the Fall Convention and Spring Conference.

ARTICLE V

Local Sections

Section 1. An area group may form a Section of this Association, subject to the approval of the Governing Board, and its name shall indicate such affiliation. Application for the formation of a Section, with its proposed name and area, accompanied by a copy of its proposed Constitution and By-Laws, shall be filed with the Secretary-Treasurer of the Association at least sixty days before the annual meeting and copies thereof shall be transmitted by him to members of the Governing Board. Action of the Governing Board upon the application shall be taken at the next annual meeting.

Section 2. Membership in a Local Section shall be limited to members of the Association who are located within the Section area. No member shall be enrolled in more than one Section.

Section 3. Dues may be fixed by each Section which shall not include membership dues in the Association.

Section 4. Each Section shall have at least one officer known as the Section Secretary-Treasurer. Prior to the annual meeting of the Association he shall submit to the Secretary-Treasurer of the Association a report of the membership, activities and finances of the Section.

Section 5. Each Section shall conduct its meetings and regulate its business in a manner consistent with the objects and policies of the Association.

ARTICLE VI

Amendments

Amendments to the By-Laws may be made by a two-thirds vote of the members at the annual meeting, after notice of the proposed amendments shall have been mailed to each member in advance.

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No single unit shows such a wide margin of superiority over common sedimentation practice. No unit can be "supercharged" to even higher margins of superiority by the simple addition of chemicals.

● A detailed paper on the Dorrco Clariflocculator with seven tables of data will gladly be sent on request.

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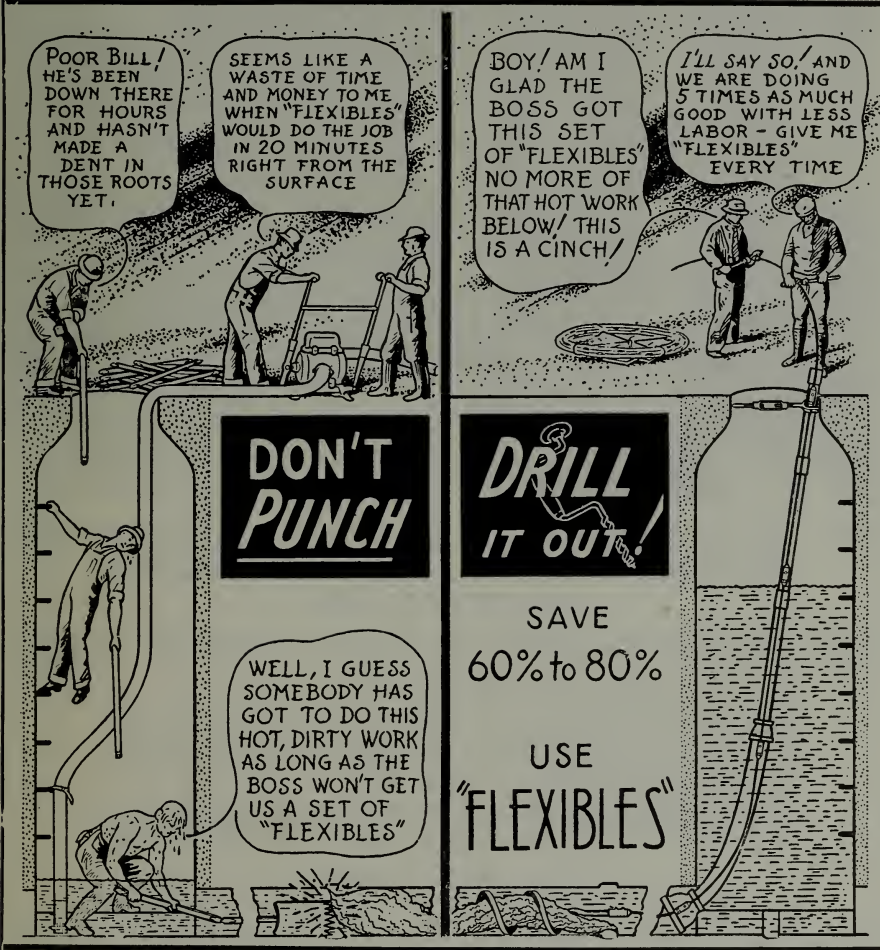
MODERNIZE YOUR DEPARTMENT

WITH

FLEXIBLES


POOR BILL! HE'S BEEN DOWN THERE FOR HOURS AND HASN'T MADE A DENT IN THOSE ROOTS YET.
SEEMS LIKE A WASTE OF TIME AND MONEY TO ME WHEN "FLEXIBLES" WOULD DO THE JOB IN 20 MINUTES RIGHT FROM THE SURFACE
BOY! AM I GLAD THE BOSS GOT THIS SET OF "FLEXIBLES" NO MORE OF THAT HOT WORK BELOW! THIS IS A CINCH!
I'LL SAY SO! AND WE ARE DOING 5 TIMES AS MUCH GOOD WITH LESS LABOR - GIVE ME "FLEXIBLES" EVERY TIME
DON'T PUNCH
DRILL IT OUT!
WELL, I GUESS SOMEBODY HAS GOT TO DO THIS HOT, DIRTY WORK AS LONG AS THE BOSS WON'T GET US A SET OF "FLEXIBLES"

SAVE 60% to 80%

USE "FLEXIBLES"

Write for our New 1940 Catalog and Operation Data Today

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TWO STRAIGHTLINE BAR SCREENS IN SAN FRANCISCO'S NEW RICHMOND SUNSET SEWAGE TREATMENT PLANT IN GOLDEN GATE PARK

EACH DESIGNED TO HANDLE AN AVERAGE FLOW OF 15 M.G.D.

Also included in this plant are Link-Belt

GRIT COLLECTORS for Grease and Grit Removal Tanks
SLUDGE COLLECTORS for Rectangular Settling Tanks
SAND COLLECTORS for Pump Well
SLUDGE COLLECTORS for Rectangular Elutriation Tanks
BELT CONVEYORS Handling Sludge Cake from Filters

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SCREENS — COLLECTORS — MIXERS — AERATORS — GRIT CHAMBERS

SterElators by Everson *Measure, Mix and Feed*

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- **Automatic Water Shut-Off**
- **Automatic Gas Shut-Off**
- **Automatic Synchronization with Pump**
- **Accurate Rota Meter (Plus or Minus 1%)**
- **Single Valve regulates Gas Flow**
- **Full Vacuum Operation**
- **Tremendous Capacity Ratios (1 to 10, even 1 to 40)**
- **Multiplex Feed to 2 or more points**

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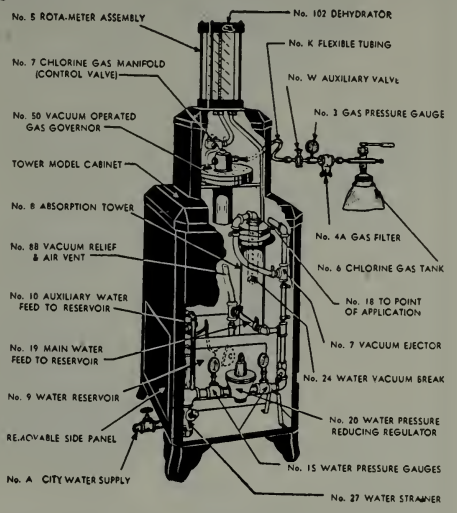
No. 5 ROTA-METER ASSEMBLY
No. 7 CHLORINE GAS MANIFOLD (CONTROL VALVE)
No. 50 VACUUM OPERATED GAS GOVERNOR
TOWER MODEL CABINET
No. 8 ABSORPTION TOWER
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HEXACHLOROETHANE IS OUT!

YOU NEED PAY NO TRIBUTE TO THIS KING OF TROUBLE-MAKERS

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Remove the "taffy" and you've solved one of your operating problems. We have reduced "taffy" to a negligible quantity in the Liquid Chlorine supplied to you. It is only one of the many improvements we have made to insure smooth operation of chlorinators.

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must be seen before they can be corrected

DOUBTLESS the gentleman on the porch is being spared a lot of mental anguish by being blissfully unaware of events behind the syringa bush—but you, who are responsible for protection of public health by chlorination, can risk no such bland ignorance in chlorinator operation.

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